Applied Research Results on Field Crop Pest and Disease Control

2018

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LIST OF CONTRIBUTORS

Private Companies

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Valent USA, LLC, Walnut Creek, CA

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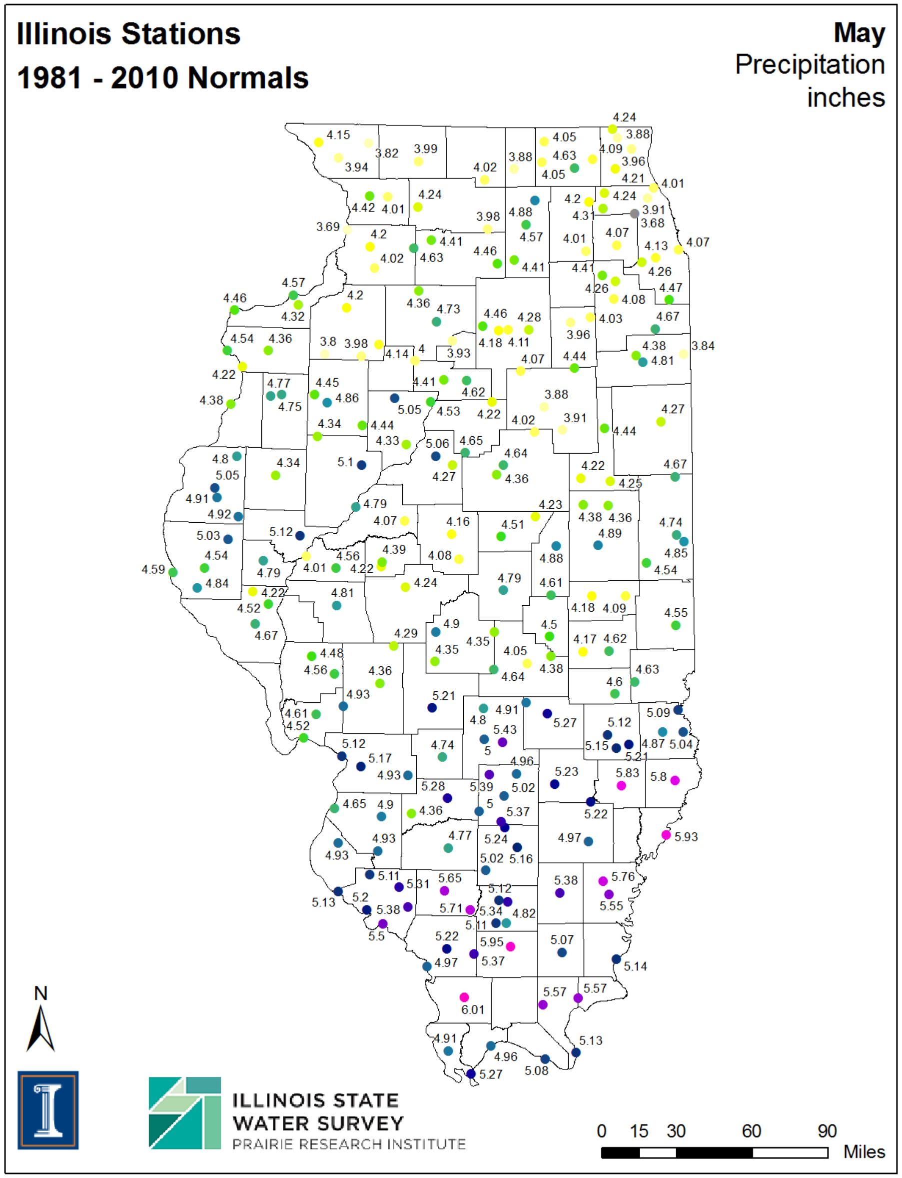

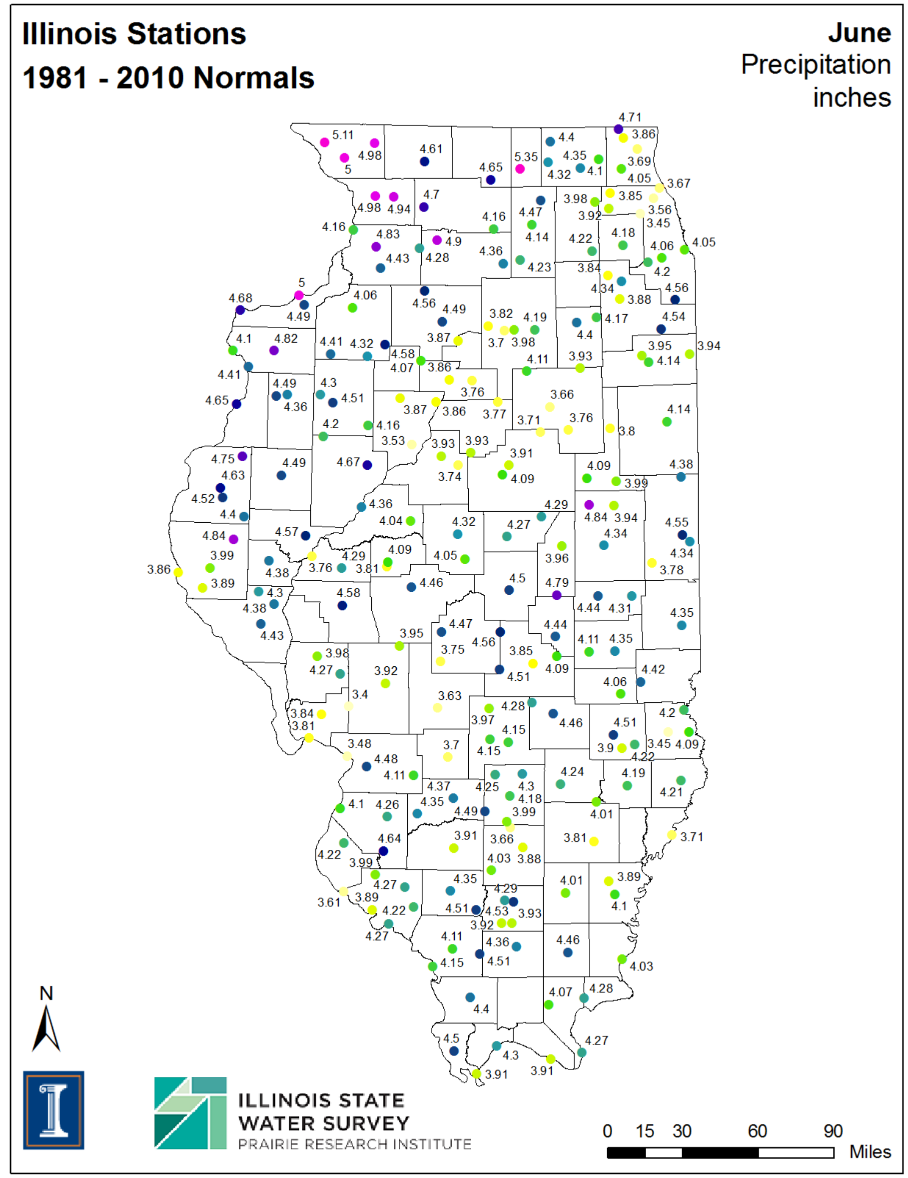

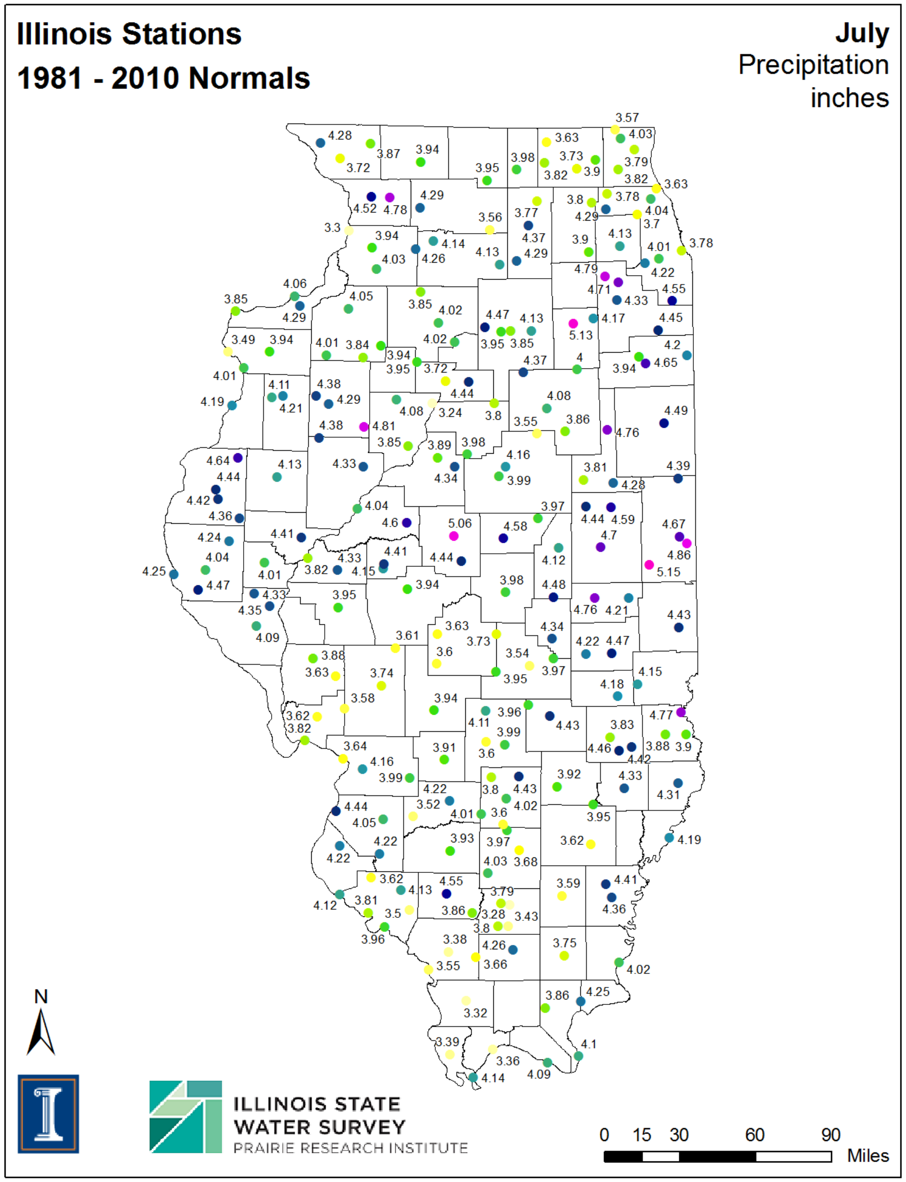
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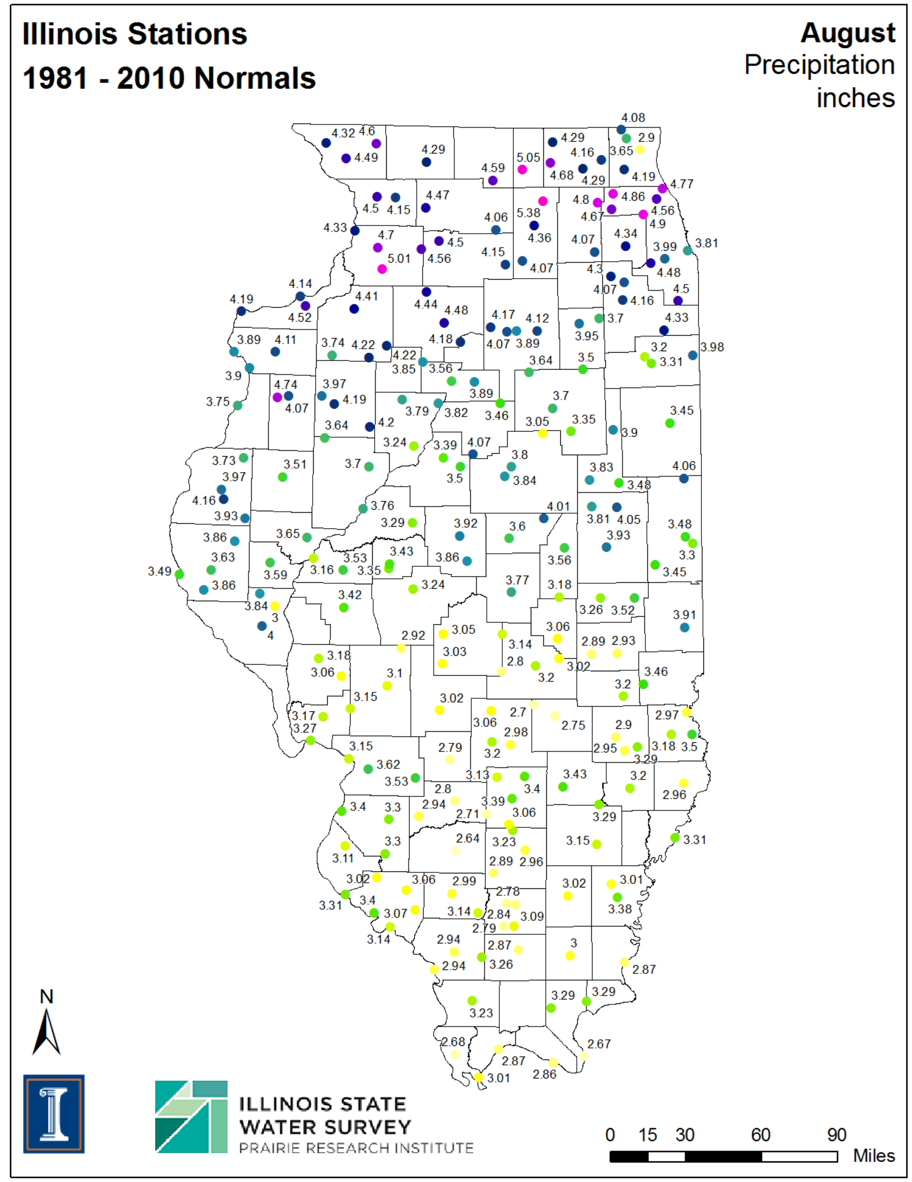
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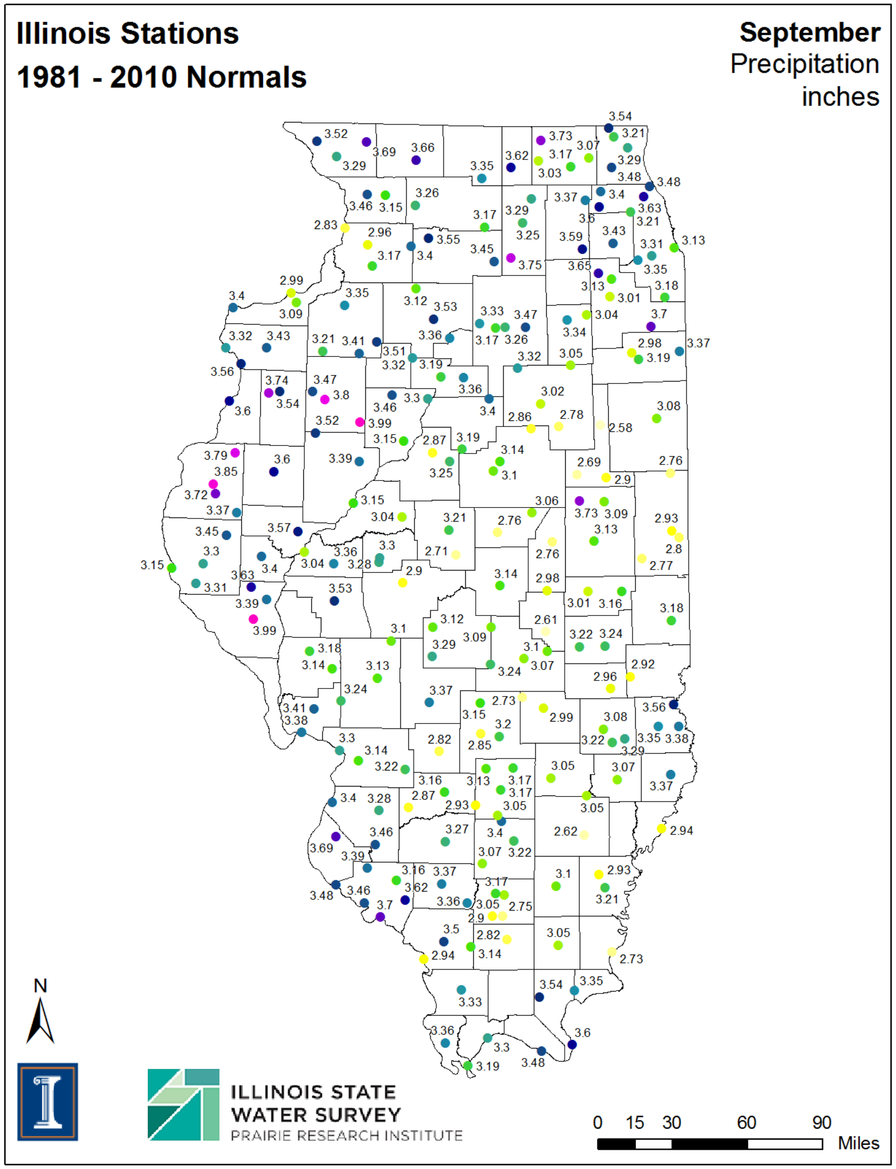
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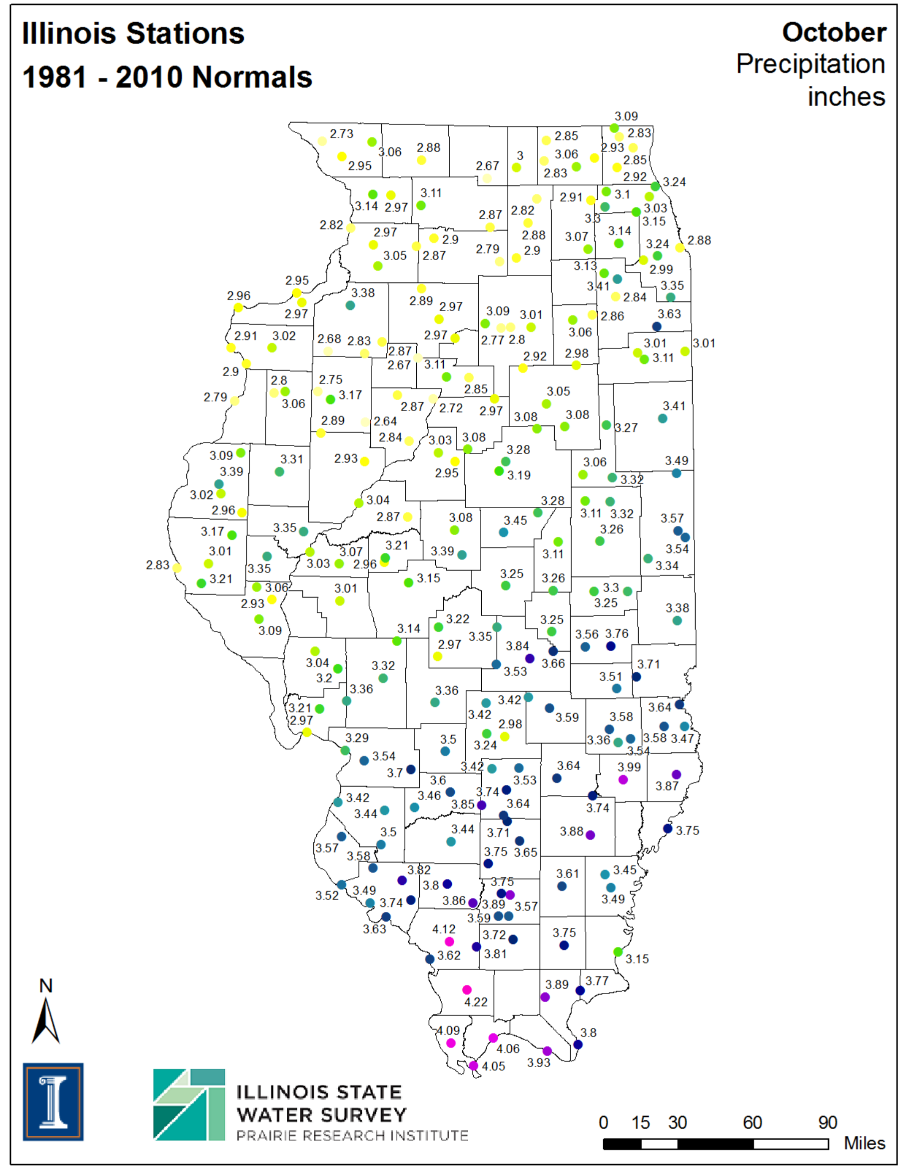
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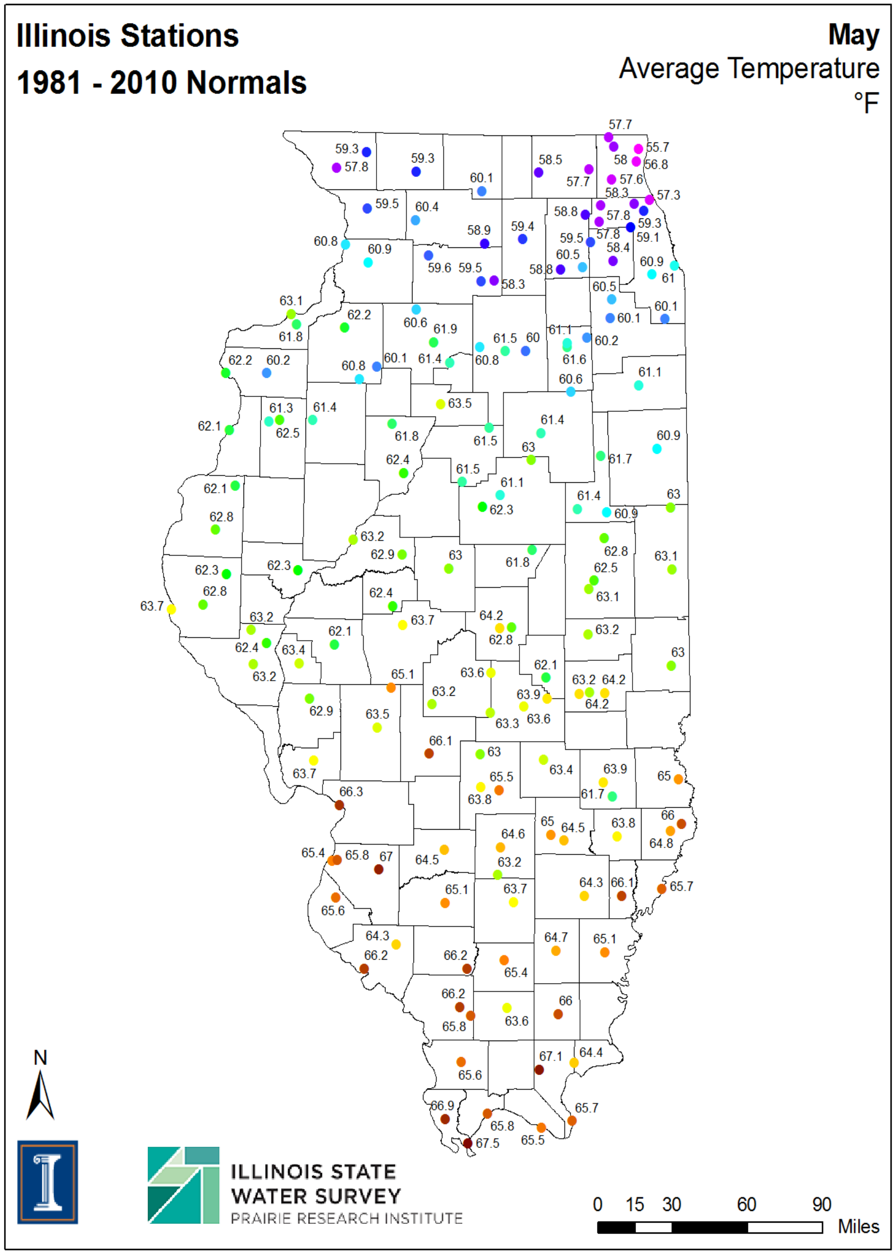
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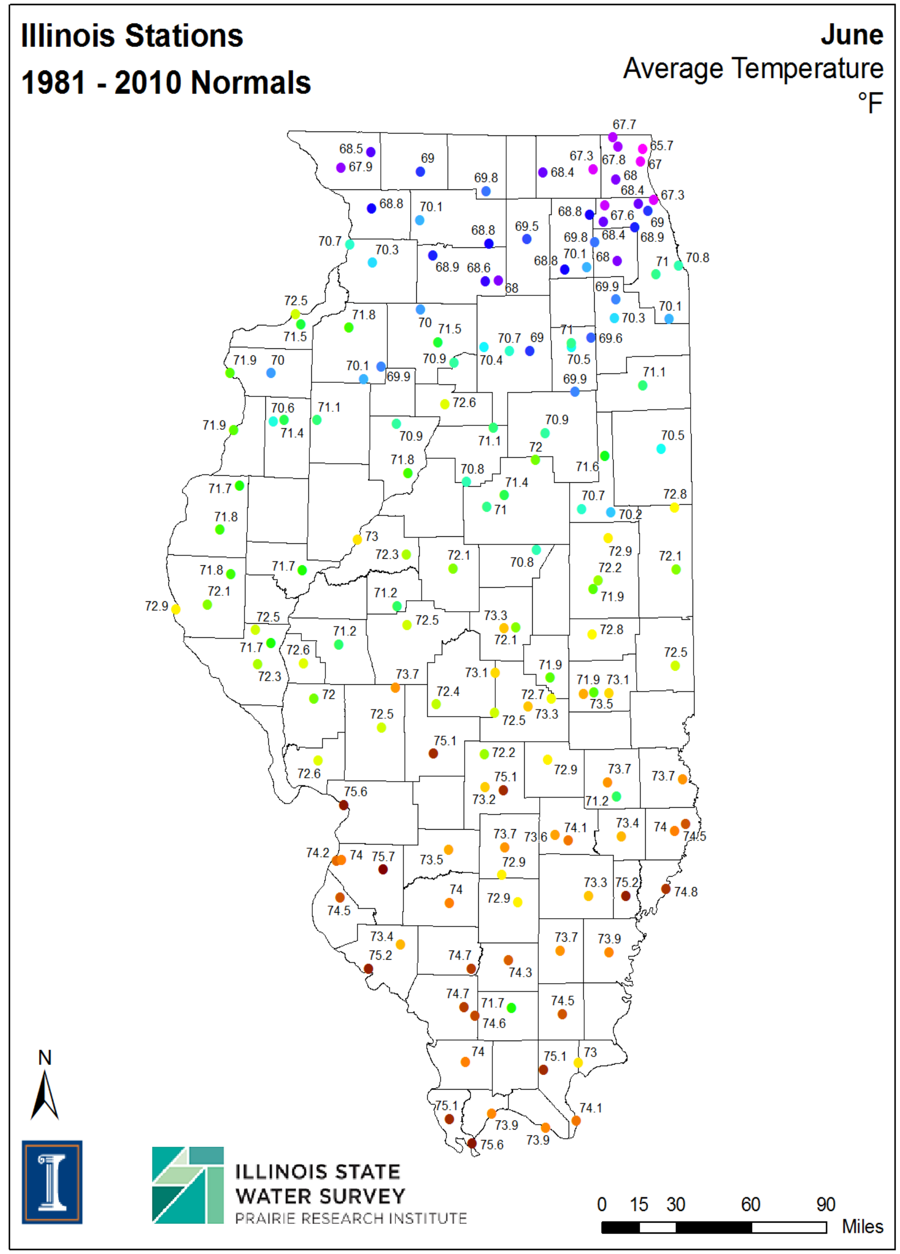
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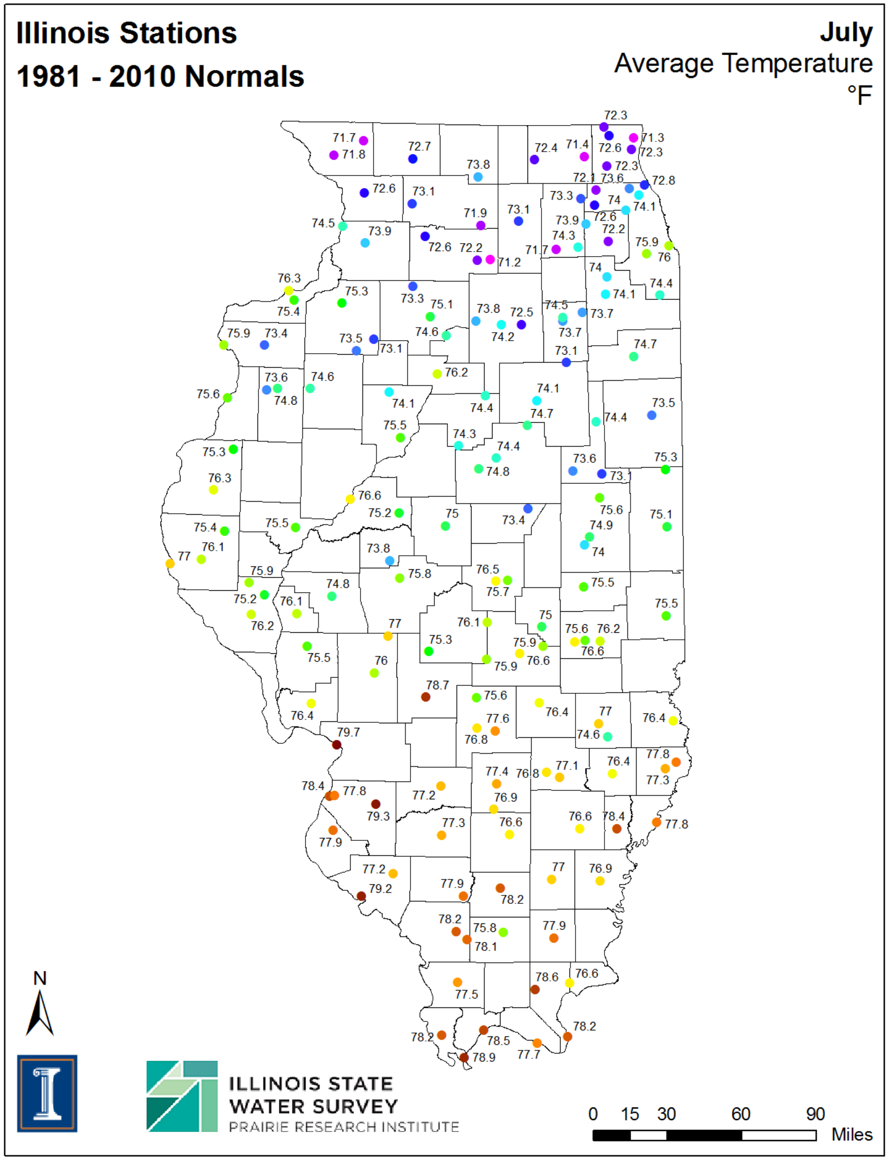
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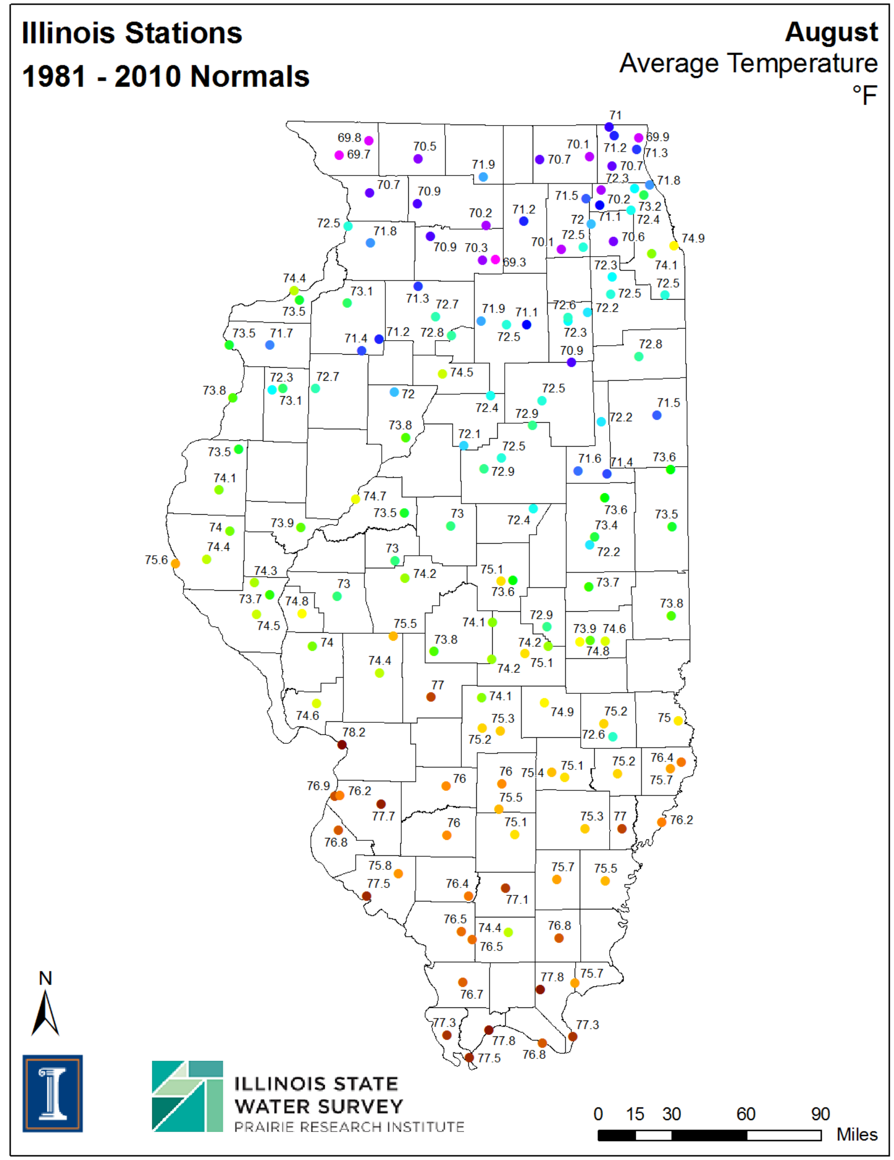
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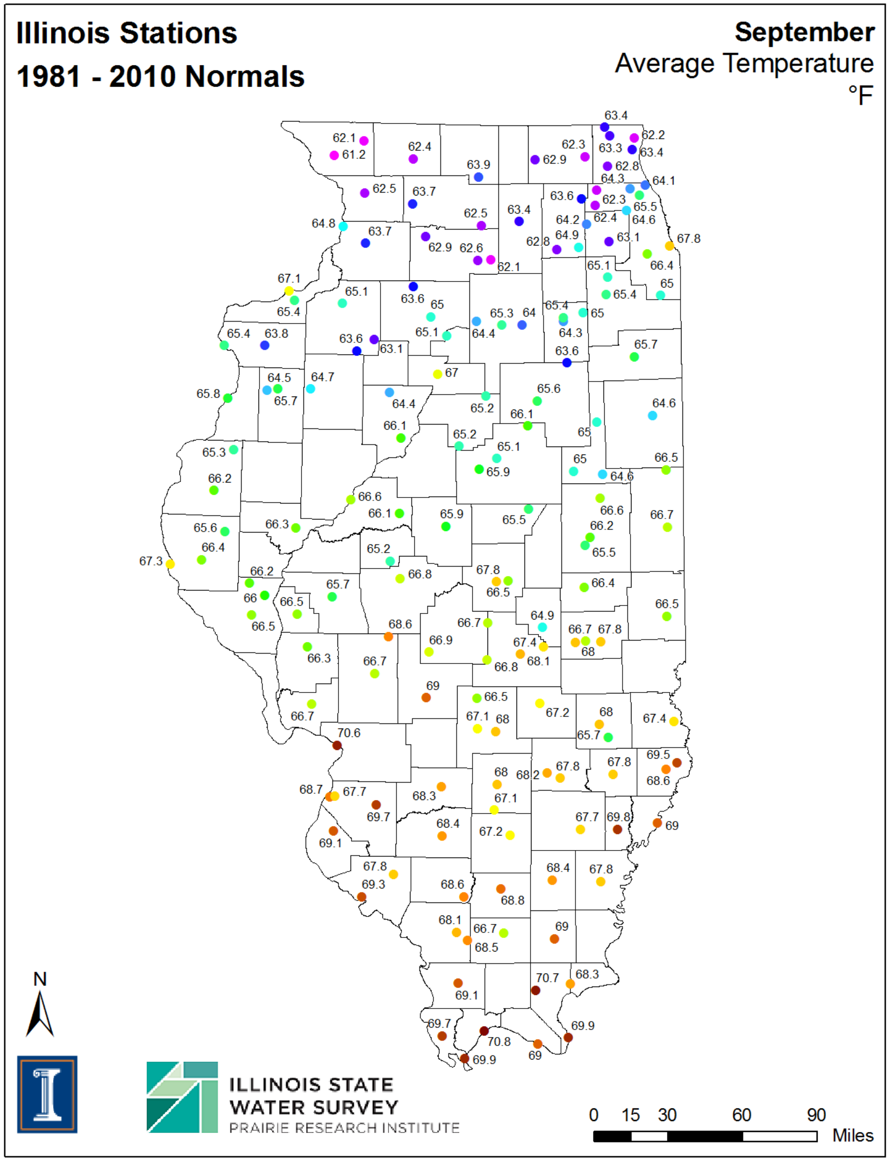
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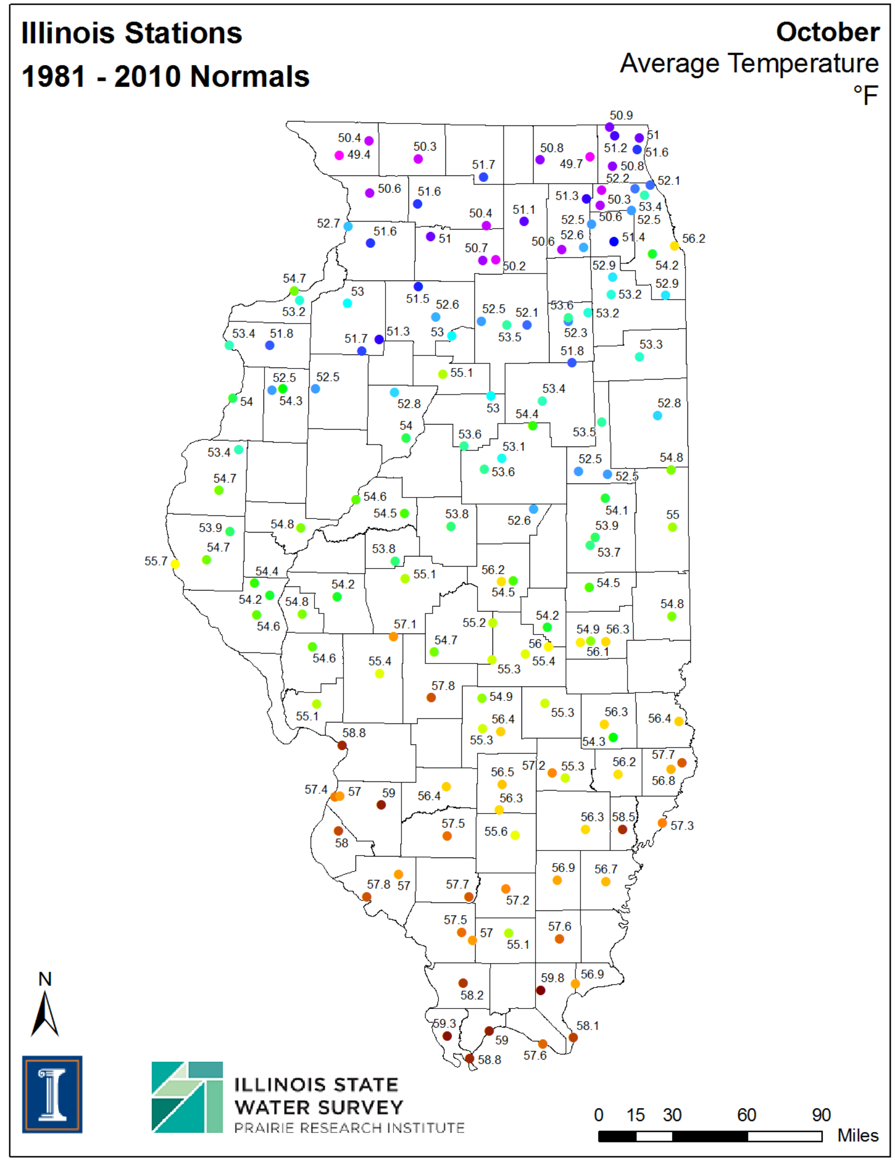
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Production (data obtained from the USDA National Agricultural Statistics Service quickstats https://www.nass.usda.gov/ accessed 12/20/2018):

Corn production in Illinois was estimated at 2.245 billion bushels in 2018, from 11 million planted acres. Total planted area was down approximately 200,000 acres from 2017. Average grain yields were 210 bu /acre, a 9 bu increase from 2017. Total silage production was 3.2 million tons from 190,000 harvested acres. Average silage yields were 17 tons / acre.

Soybean production in Illinois was estimated at 688 million bushels in 2018, from 10.8 million acres. Average grain yields were 64 bu / acre, a 6 bu increase over 2017.

Wheat production in Illinois was 36.9 million bushels in 2018 from 560,000 harvested acres. Average yields were 66 bu / acre, down from 76 bu / acre in 2017.

2018 Corn Nematode Survey

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[1]University of Illinois Department of Crop Science
[2]University of Illinois Cooperative Extension Service
[3]Illinois Natural History Survey

A survey was conducted in 2018 to assess the prevalence and abundance of parasitic nematodes associated with corn fields. A total of 70 samples were collected from across 43 counties (Figure 1). Fields were selected without knowledge of any preexisting corn nematode issue. Samples were acquired when corn was between V5 and V8, although some fields were not sampled until later due to significant rains that moved through parts of Illinois in June. For each field at least 20 cores, 8 inches deep, were collected from across each field following a "W" sampling pattern. Samples were taken within 5 inches of the stalk, pooled and mixed, placed in a gallon sized ziplock bag and immediately placed on ice in a cooler. Samples were immediately transferred to the University of Illinois Nematode Assay Service where they were stored at 4°C in a cold room prior to analysis. Samples were processed using University of Illinois Plant Clinic, Vermiform Nematode Counts standard protocol **ILPC-402.02W.**

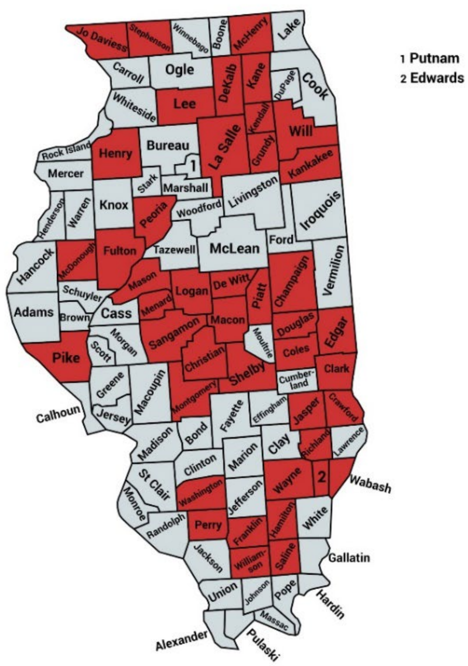


Figure 1. A total of seventy corn fields were included in the 2018 nematode survey. Counties shaded in red had at least one field assessed.

Ten different parasitic nematode genera were detected in samples across the state (Figure 2). The most prevalent corn parasitic nematodes included Spiral (97%), Lesion (81%), Stunt (30%) and lance (24%). The highly damaging Needle nematode was detected in one field in Williamson County. Vermiform Soybean cyst nematode, which is not a pathogen on corn, was prevalent, and detected in 66% of corn fields.

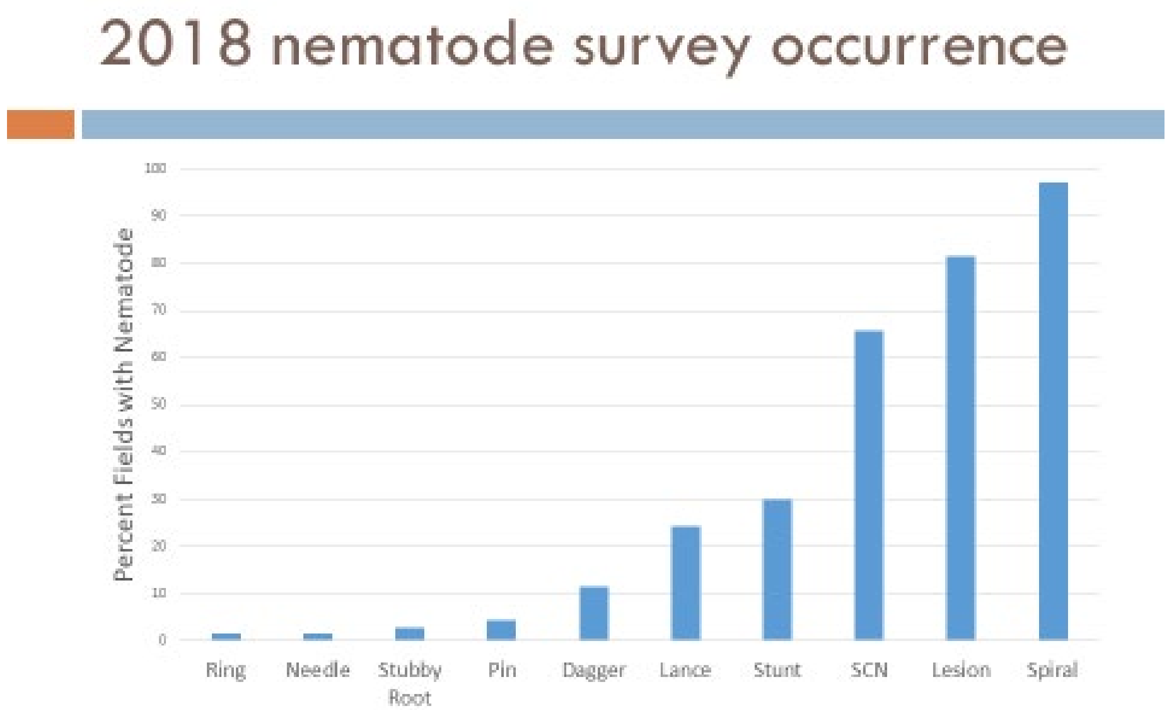


Figure 2. The Distribution of Parasitic nematode species observed in the 2018 corn nematode survey.

Six fields contained moderate and one severe levels of Spiral nematode at sampling (Figure 3). Seven fields contained moderate and five severe levels of Lesion nematode (Figure 4). No fields contained levels of Stunt or Lance nematodes that would pose a potential risk to crop production (Figure 5, 6). Most (98.5%) of fields sampled contained at least one parasitic nematode.

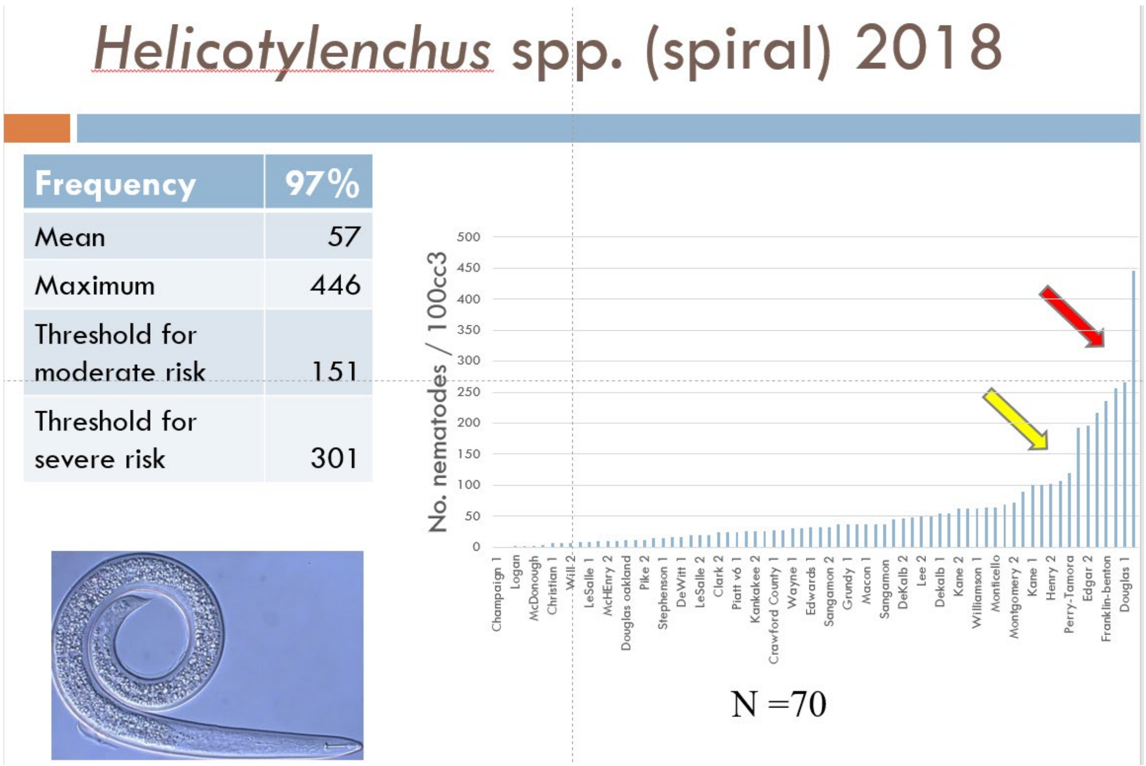


Figure 3. Spiral nematode statistics for the 2018 corn nematode survey. The majority of fields sampled did not contain levels that may affect yield, with only a single field (red arrow) exceeding the threshold for significant risk.

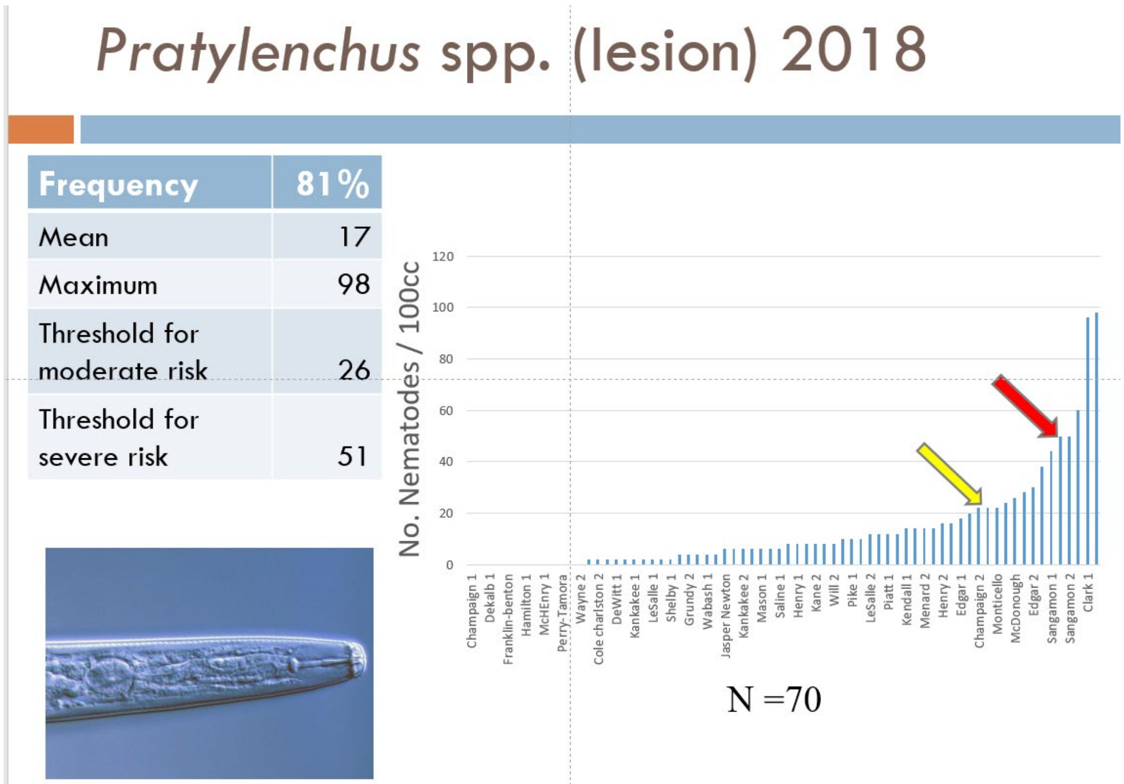
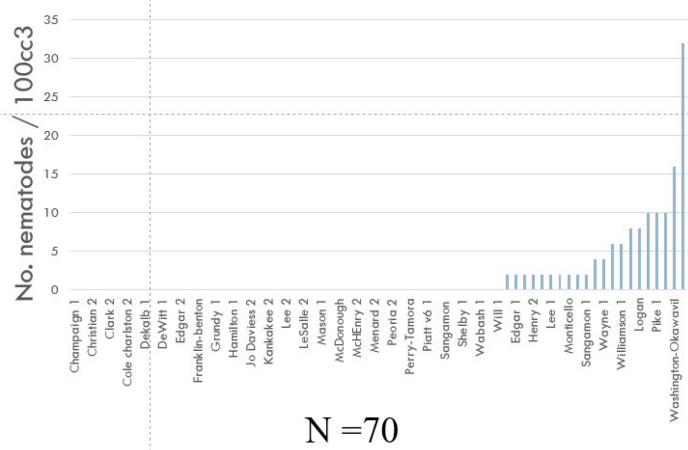


Figure 4. Lesion nematode statistics for the 2018 corn nematode survey. The majority of fields sampled did not contain levels that may affect yield, with only five fields (red arrow) exceeding the threshold for significant risk.

Stunt nematodes

Frequency	30%
Mean	6
Maximum	32
Threshold for moderate risk	51
Threshold for severe risk	101



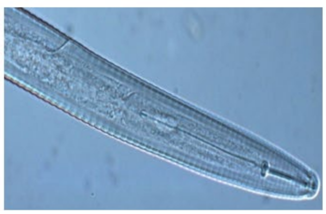
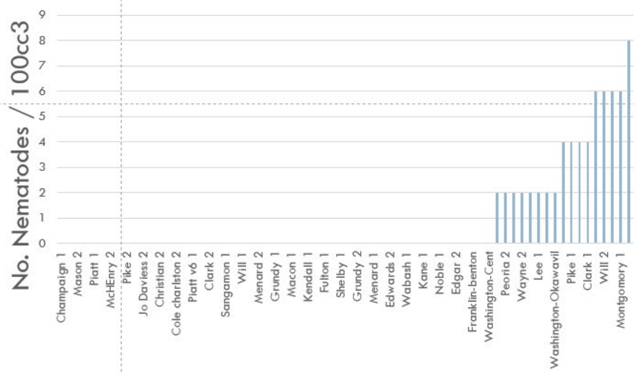


Figure 5. Stunt nematode statistics for the 2018 corn nematode survey. No fields sampled contained levels of this nematode considered to impact corn production.

Hoplolaimus sp. (lance) 2018

Frequency	24%
Mean	1
Maximum	8
Threshold for moderate risk	41
Threshold for severe risk	76



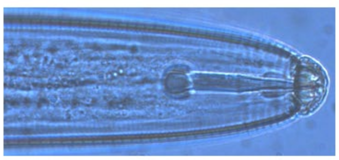


Figure 6. Lance nematode statistics for the 2018 corn nematode survey. No fields sampled contained levels of this nematode considered to impact corn production.

Summary

This survey showed that although several general can be found in cornfields throughout Illinois, only a small subset might contain numbers considered to impact corn productivity. Producers considering including additional management inputs targeting nematodes should consider sampling fields the year prior to planting corn to assess the need for additional management. Fields in sandy soils and containing corn on corn production are likely to be at the greatest risk for elevated levels of parasitic nematodes. This study will be repeated in the 2019 season. **If you are interested in having your fields included in the survey contact your regional University of Illinois Extension Educator or Dr. Kleczewski at nathank@illinois.edu**

Corn Hybrid Response to Tar Spot

In 2018 persistent wet weather and moderate temperatures in mid-late June and again from late August through October resulted in a severe outbreak of Tar spot in corn. Estimated yield losses caused directly by this disease vary by location within Northern Illinois, but range anywhere from 10-40 bu /A. The University of Illinois Variety Trials Program placed one of their OVT trials located at the Northern Illinois Research Center (https://web.extension.illinois.edu/niarc/). This trial consisted of 98 corn hybrids replicated three times in a completely randomized block design. Hybrids maturities ranged from 102-114 days. Plots were 10' x 25', and nutrient and weed management followed. On 9/4/18, plots were rated for tar spot severity when plants were at approximately R6. No other foliar diseases were evident in this trial. Tar spot was rated by rating the ear leaves of six plants within an 8 foot section from the center rows two rows of each plot for percentage of leaf area with black "tar spots". A standard area diagram for common rust of corn was used to help standardize disease ratings and ensure accuracy. The average amount of tar spot per plot (severity) was calculated per plot. Plots were harvested using a small plot combine, adjusted to 15% moisture. Severity data were statistically analyzed using a mixed model with blocks assigned as random factors and hybrid identity as fixed factors (JMP v 12.) Data were arcsin transformed to meet assumptions of ANOVA and mean separations conducted using Fishers protected LSD (α =0.05). Linear regression was used to determine the relationship between tar spot severity and yield across hybrids, and within early (102-108) and late (109-114) hybrid categories.

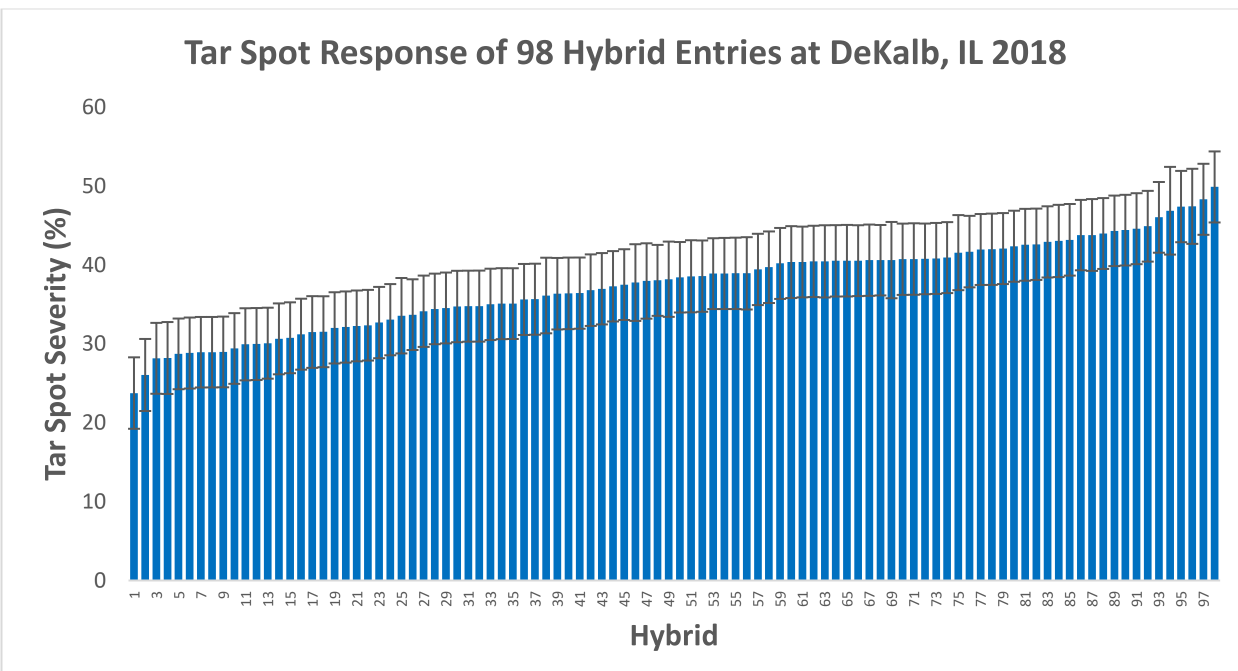


Figure 1. Average tar spot severity ratings and LS errors for 98 corn hybrids located in the DeKalb OVT. Overall, hybrids appeared susceptible to tar spot, as expected. However, some hybrids appeared to be

more tolerant to tar spot in comparison to other hybrids in this trial. No company appeared to have consistently better or worse hybrids than others included in this trial.

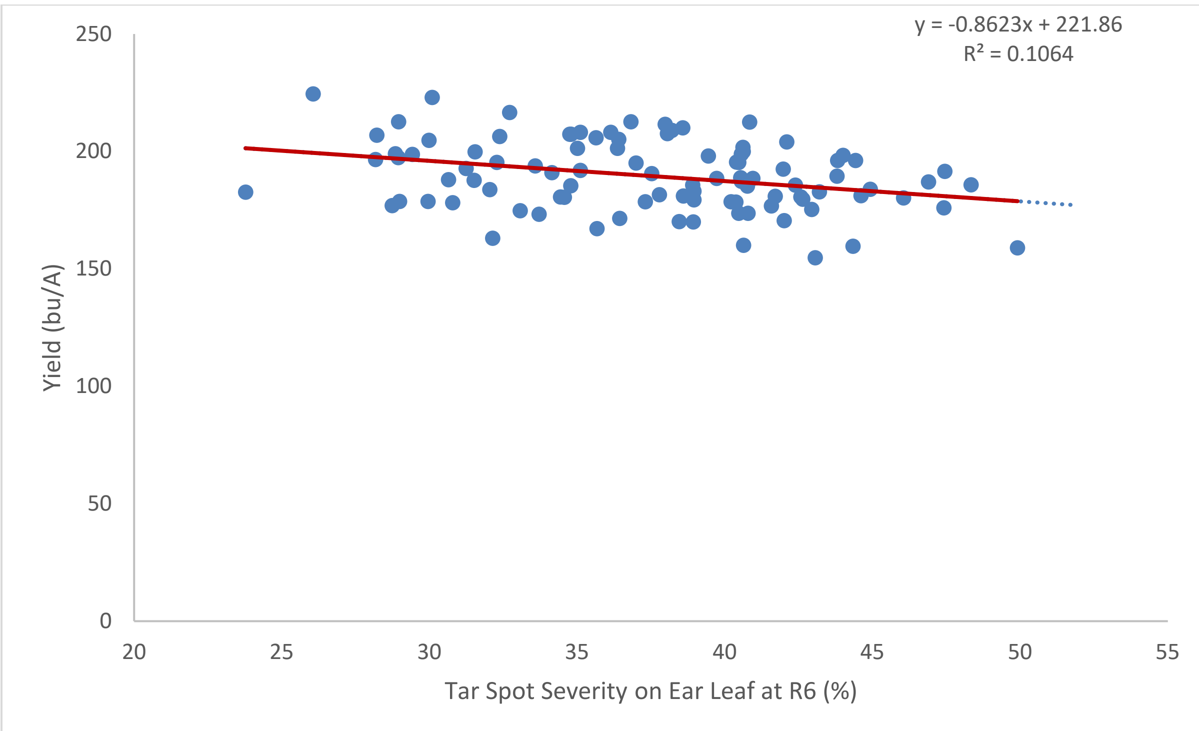


Figure 2. The relationship between tar spot severity and yield across all 98 hybrids assessed at DeKalb, IL at the R6 growth stage. Each point represents the average of three replicates per hybrid.

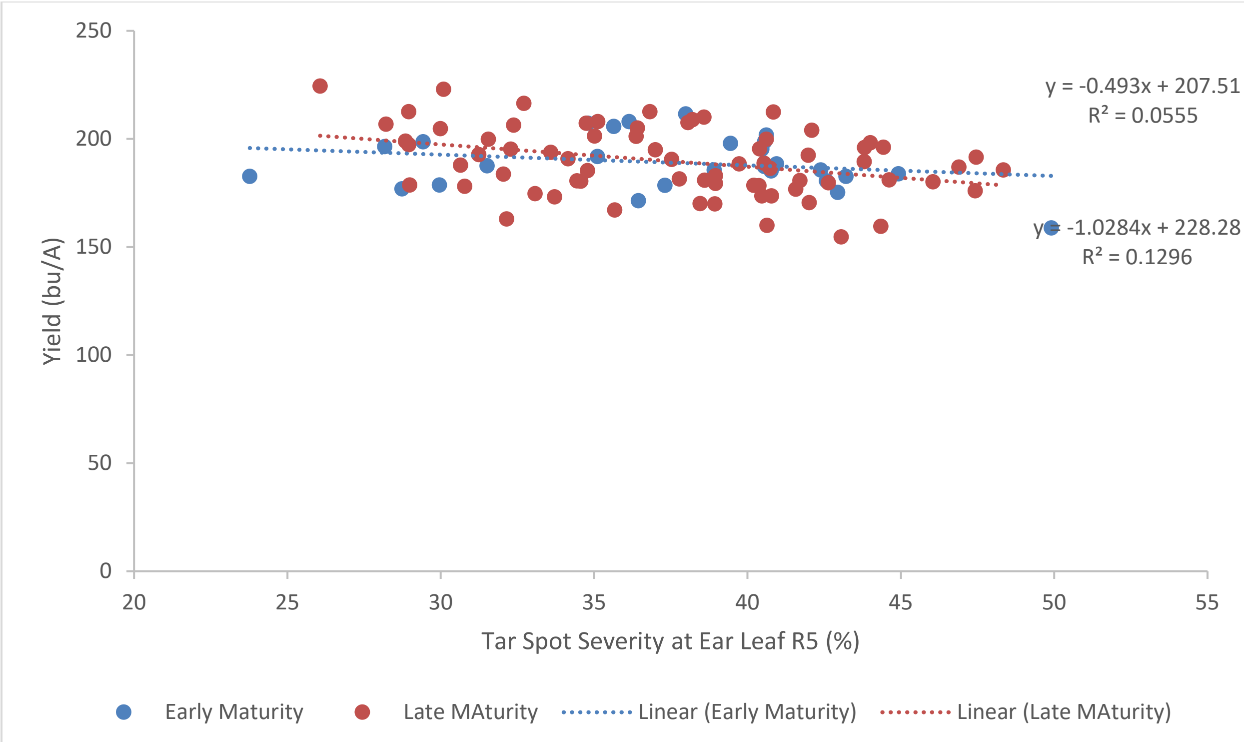


Figure 3. The relationship between tar spot severity and yield for 102-108 day (early) maturity hybrids and 109-114 day (late) hybrids assessed at the R6 growth stage.

Results

Data indicate that all hybrids tested in the 2018 OVT were susceptible to tar spot, although some hybrids appeared to have greater levels of tolerance than others. Estimates for yield loss resulting from tar spot range from 0.4-1 bu/A for every percent of tar spot present on the ear leaf at R6. Regression analyses indicate that there may be a more severe impact of tar spot on later maturing hybrids when compared to early maturing hybrids. However, this could be related to disease onset and development relative to hybrid maturity. For example, earlier maturing hybrids may have been further along in development and therefore less impacted by late season development of tar spot compared to late maturing hybrids. When statistically analyzed, early and late maturity hybrids did not differ in overall tar spot severity (P=0.42). More data are required to better determine the role of maturity on tar spot development. Overall, it does not appear that producers will have many options regarding hybrid selection for tar spot. However, producers are encouraged to discuss hybrid performance with their seed dealers and look for future publications on hybrid response to tar spot from the Crop Protection Network. Selecting a hybrid with a greater tar spot tolerance may reduce the potential impacts of this disease, were it to occur in 2019.

Corn (*Zea mays*)
Disease: Grey Leaf Spot (Cercospora zea maydis)

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Effect of foliar fungicide on corn disease severity and yield, 2018.

Plots were established at the CSREC in Urbana, IL in 2018. This trial was planted using an Almaco 360 research plot planter on 5/9/18. Planting population was 34000 ppa and the hybrid was G11U58-3122. The plot size was four (30”) rows wide by 25 feet long. The experimental design was a randomized complete block design with four replications. Fungicide applications were applied using a hand held 4-nozzle research sprayer. The sprayer was set at 40 PSI using XR 8002 nozzles and applied at 3 mph. This set up achieved an application rate of 20 gpa. Treatments were applied at the V6, V7, 5 days prior to VT, VT, R3 and R5 growth stage. Disease ratings were taken on 8/9/18 by rating 5 leaves at 4 locations in the canopy (Ear leaf (EL), EL +1, EL-1, and EL-2) for percent leaf area affected by grey leaf spot. Ten feet of a center row was pushed 30 degrees from vertical, and the number of lodged stalks counted relative to the total number of stalks pushed on 8/22/18. That same day, the percent of the center two rows remaining green was visually estimated. Plots were harvested in Urbana using a Massey 8XP research plot combine. Yields were calculated based on a 56 lb. bushel weight and adjusted to 15% moisture. Data were analyzed by ANOVA and Fisher’s LSD at $P \leq 0.05$ was calculated for mean comparisons.

Even though disease pressure was extremely light, foliar disease severity on all leaves rated was significantly affected by a foliar fungicide when applied at the R1 growth stage. Two pass programs did not significantly improve disease reduction compared to solo, R1 applications. Significant differences were not seen in stay green ratings or push test used to determine stalk quality. Treatments were not significantly different for moisture, test weight or yield.

Table 1. Effect of foliar fungicide on grey leaf spot disease severity, stay green, stalk quality and yield of corn.

Treatment Name	Rate *	Growth Stage	8/9/18 (R5) (%LAI) Grey Leaf Spot Ear Leaf	Earl Leaf +1	Ear Leaf-1	Earl Leaf -2	8/22/2018 % plant green Stay Green	8/22/2018 Push Test % Broke Stalks	lbs./bu Test Weight	Adj to 15% Bu/A Yield
Delaro	4	V6	0.9	0.5	1.2	1.5	61.3	2.6	56.1	247.5
Delaro	8	R1	0.5	0.2	0.5	0.8	53.8	4.7	56.0	232.3
Aproach	6	V7	0.8	0.4	1.0	1.4	60.0	5.6	54.3	232.1
Aproach Prima	6.8	R1	0.3	0.1	0.3	0.9	63.3	6.9	56.2	232.2
Trivapro	13.7	R1	0.7	0.4	0.7	0.7	62.5	0.0	56.0	233.4
Miravis Neo	13.7	R1	0.4	0.1	0.7	0.9	55.0	6.1	54.8	245.8
Delaro	8	R1	0.4	0.2	1.1	1.7	62.5	1.6	55.9	244.1
Headline AMP	10	R1	0.5	0.2	0.9	1.3	65.0	4.0	54.7	250.4
Aproach Prima	6.8	R5	1.0	0.7	1.3	2.2	63.8	3.0	56.6	244.9
Trivapro	13.7	R5	1.2	0.7	1.2	1.4	63.8	2.8	54.8	239.1
Miravis Neo	13.7	R5	0.8	0.5	1.1	1.9	58.8	4.2	56.6	241.4
Delaro	8	R5	1.0	0.4	1.1	2.0	63.8	0.0	55.6	241.4
Headline AMP	10	R5	0.7	0.6	0.9	1.2	57.5	3.0	56.3	238.4
Aproach Prima	6.8	R3	1.0		1.0	1.4	61.3	4.4	54.7	241.9
Trivapro	13.7	R3	1.0	0.6	1.4	1.8	60.0	0.0	56.0	244.5
Miravis Neo	13.7	R3	0.8	0.5	1.4	1.7	62.5	1.3	55.8	241.1
Delaro	8	R3	0.8	0.3	0.9	1.5	60.0	2.4	56.8	243.7
Headline AMP	10	R3	0.7	0.4	0.8	1.5	58.8	4.4	55.8	245.5
Priaxor FB	4	V5 FB								
Headline AMP	10	R1	0.4	0.3	0.7	1.1	57.5	4.4	55.6	243.5
Stratego YLD FB	5	V5 FB								
Delaro	8	R1	0.1	0.0	0.3	0.5	60.0	2.7	56.1	242.4
Lucento FB	5	V5 FB								
Topguard EQ	7	R1	0.3	0.2	0.5	0.4	58.8	1.6	55.4	245.4

Tilt FB	4	V5 FB								
Trivapro	13.7	R1	0.4	0.1	0.9	1.0	58.3	1.9	55.2	244.0
Tilt	4	V5	0.9	0.6	1.1	1.8	65.0	1.3	54.4	247.6
Tilt	4	R1	0.5	0.3	1.0	1.7	60.0	5.2	56.4	245.4
Tilt	4	R5	0.4	0.3	0.9	1.2	61.3	2.8	55.9	242.9
Proline FB	5.7	R1 FB								
Proline	5.7	R5	0.5	0.0	1.0	1.5	60.0	1.4	55.0	232.4
Affiance	10	V5	0.7	0.6	1.5	1.7	61.7	3.7	56.3	239.3
Affiance	10	R1	0.2	0.1	1.0	0.8	58.3	0.0	56.0	246.3
Affiance	10	R5	1.3	0.6	1.5	1.9	50.0	1.9	55.5	222.0
Control	**.**	**.**	**0.8**	**0.4**	**1.2**	**1.4**	**65.0**	**2.1**	**55.6**	**254.4**
		P > F	0.0008	0.0031	0.0016	0.0001	0.9477	0.3163	0.1939	0.6293
		LSD 0.05	0.52	0.41	0.56	0.77	n.s.	n.s.	n.s.	n.s.
		CV%	52	74	39	39	13.6	127	2	4.5

*Rate is presented in fl oz. /A. FB = Followed by.

Soybean (*Glycine max)*

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Effect of foliar fungicide on soybean disease severity and yield, 2018.

A trial was conducted at the CSREC in Urbana, IL. This trial was planted using an Almaco 360 research plot planter on 5/16/18. Planting population was 140000 ppa and the variety was NK S29-K3X. The plot size was four (30") rows wide by 20 feet long. The experimental design was a randomized complete block design with four replications. Fungicide applications were applied using a hand held 4-nozzle research sprayer. The sprayer was set at 40 PSI using XR 8002 nozzles and applied at 3 mph. This set up achieved an application rate of 20 GPA. All treatments received NIS at 0.25%. Treatments were applied at the V5, R1, R3 and R5 growth stage. Disease evaluations were not taken due to lack of foliar disease. Plant canopy NDVI was taken 4 times throughout the growing season using the GreenSeeker handheld crop sensor. Plots were harvested in Urbana using a Massey 8XP research plot combine. Yields were calculated based on a 60 lb. bushel weight and adjusted to 13.5% moisture. Data were analyzed by ANOVA and Fisher's LSD at $P \leq 0.05$ was calculated for mean comparisons.

In the absence of foliar disease, foliar fungicide did not have a significant effect on either plant canopy color at any of the rating dates or yield.

Table 1. Effect of foliar fungicide on plant canopy greenness and yield.

Treatment Name	*Rate	Growth Stage	7/26/2018 Green seeker	8/2/2018 Green seeker	8/9/2018 Green seeker	8/30/2018 Green seeker	% Moisture	lbs./bu Test Weight	adj to 13% bu/A Yield
Untreated Control			0.91	0.89	0.88	0.79	13.5	54.5	69.1
Priaxor	4	R3							
Domark	4	R3	0.91	0.89	0.88	0.84	13.3	54.9	67.0

Stratego YLD	4.5	R3	0.89	0.89	0.89	0.84	13.2	54.8	67.8
Delaro	8	R3	0.90	0.89	0.88	0.78	13.2	54.2	70.9
Miravis Top	13.7	R3	0.90	0.89	0.88	0.84	13.2	54.9	66.1
Miravis Neo	13.7	R3	0.91	0.90	0.89	0.83	13.1	54.5	70.5
Trivapro	13.7	R3	0.92	0.91	0.90	0.79	13.4	54.7	75.7
Quadris Top SBX	7	R3	0.91	0.91	0.90	0.76	13.3	54.3	76.1
Stratego YLD	4.5	V5	0.91	0.89	0.89	0.78	13.4	54.8	74.7
Delaro	8	V5	0.91	0.90	0.89	0.82	13.3	54.5	74.6
Miravis Top	13.7	V5	0.91	0.91	0.88	0.64	13.4	54.5	78.9
Miravis Neo	13.7	V5	0.91	0.91	0.89	0.75	13.4	54.8	74.7
Trivapro	13.7	V5	0.91	0.90	0.88	0.82	13.3	54.8	72.2
Quadris Top SBX	7	V5	0.91	0.90	0.89	0.76	13.3	54.4	76.4
Stratego YLD	4.5	R1	0.90	0.90	0.88	0.82	13.1	54.8	67.0
Delaro	8	R1	0.91	0.90	0.88	0.82	13.3	54.5	71.4
Miravis Top	13.7	R1	0.91	0.90	0.88	0.78	13.5	54.5	77.8
Miravis Neo	13.7	R1	0.92	0.91	0.89	0.79	13.2	54.4	71.6
NIS	0.25	R1							
Trivapro	13.7	R1	0.90	0.90	0.89	0.82	13.4	54.6	74.8
Quadris Top SBX	7	R1	0.90	0.90	0.89	0.80	13.3	54.7	72.8
Tilt	6	V5	0.90	0.90	0.89	0.84	13.2	54.6	72.4
Tilt	6	R1	0.92	0.90	0.89	0.79	13.2	55.6	74.6
Tilt	6	R3	0.91	0.90	0.89	0.81	13.4	54.7	70.6
Aproach	8	V5	0.91	0.90	0.89	0.82	13.2	55.0	72.8
Aproach	8	R1	0.91	0.90	0.89	0.82	13.1	54.4	72.3
Aproach	8	R3	0.92	0.91	0.89	0.81	13.4	54.7	72.1
Aproach Prima	6.8	V5	0.91	0.90	0.89	0.79	13.1	54.8	72.0

Aproach Prima	6.8	R1	0.91	0.90	0.89	0.81	13.2	54.7	69.8
Aproach Prima	6.8	R3	0.91	0.90	0.89	0.81	13.2	54.6	76.8
Priaxor	4	V5	0.90	0.90	0.88	0.78	13.0	54.7	72.7
Priaxor	4	R1	0.91	0.90	0.88	0.81	13.4	54.7	73.7
Priaxor	4	R3	0.91	0.90	0.89	0.80	13.2	54.1	73.4
Endura	8	R1	0.91	0.90	0.89	0.76	13.2	54.7	75.2
Endura	8	R3	0.91	0.90	0.88	0.83	13.1	54.7	66.2
Affiance	10	V5	0.91	0.90	0.89	0.81	13.3	54.7	75.7
Affiance	10	R1	0.90	0.89	0.88	0.84	13.1	54.8	68.7
Affiance	10	R3	0.91	0.90	0.89	0.81	13.4	54.8	73.3
Priaxor D	4	V5	0.91	0.91	0.89	0.77	13.4	54.2	74.1
Priaxor D	4	R1	0.91	0.91	0.89	0.79	13.5	54.8	70.6
Priaxor D	4	R3	0.90	0.90	0.89	0.81	13.3	54.3	72.2
Tilt FB	4	V5 FB							
Trivapro	13.7	R1	0.91	0.91	0.89	0.83	13.0	54.7	66.5
Tilt FB	4	V5 FB							
Trivapro	13.7	R3	0.91	0.90	0.89	0.76	13.3	54.3	72.8
Tilt FB	4	V5 FB							
Aproach	8	R1	0.90	0.90	0.89	0.80	13.2	54.5	70.9
		P > F	0.0808	0.0826	0.3159	0.3914	0.3647	0.1712	0.1404
		LSD 0.05	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
		CV%	1	1.2	1	37	1.9	0.83	7.9

Soybean (*Glycine max)*
Heterodera glycines

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Effect of seed treatment in high SCN environments on soybean plant population and yield, 2018.

A trial was conducted at the Northwestern Illinois Agricultural Research and Demonstration Center in Monmouth, IL. This trial was planted using an Almaco 360 research plot planter on 5/18/18. The planting population was 140000 ppa. The plot size was 4 (30") rows wide by 20 feet long. The experimental design was a randomized complete block design with 4 replications. Soil samples were taken prior to planting to establish a baseline nematode population. Results from those initial tests concluded that the nematode population was 9760 eggs per 100 CC of soil. Plant stands were taken 13 and 45 days after planting. Plots were harvested using a Massey 8XP research plot combine. Data were analyzed by ANOVA and Fisher's LSD at P≤0.05 was calculated for mean comparisons. Yields were calculated based on a 60 lb bushel weight and adjusted to 13.5% moisture.

Seed treatment did not have a significant effect on plant population at either timing or yield.

Effect of seed treatment in high SCN environments on soybean plant population and yield.

Trt #	Treatment	Conc	Unit			10 DAP 5/31/18 (V1) Plants/A Population	28 DAP 7/2/2018 Plants/A Population	lbs/bu	10/2/2018 adj to 15% bu/A
1	UNTREATED CHECK					119354	126905	54.3	63.8
2	Trt 2	2.33	LBAI/GALFS	3.37	FLOZ/CWT	125017	129809	53.7	64.3
3	Trt 2	2.33	LBAI/GALFS	3.37	FLOZ/CWT	116741	126614	54.1	62.9
	AVEO EZ (MINIMUM 61 BCFU/ML)	115.6	BCFU/mL FS	0.2	FLOZ/CWT				
4	CRUISERMAXX VIBRANCE	2.49	LBAI/GALFS	3.22	FLOZ/CWT	108682	135617	53.8	66.2
	CLARIVA PN (USA 10 BCFU/ML)	10	BCFU/mL FS	1	FLOZ/CWT				
5	ACCELERON DX-109 (Pyraclostrobin)	1.67	LBAI/GALFS	0.8	FLOZ/CWT	128720	123710	54	58.6
	ACCELERON DX-309 (Metyaxyl)	2.6	LBAI/GALFS	0.4	FLOZ/CWT				
	ACCELERON DX-612 (Fluxipyroxad 2.7)	2.72	LBAI/GALFS	0.24	FLOZ/CWT				
	PONCHO VOTIVO	5.01	LBAI/GALFS	2.04	FLOZ/CWT				
6	Trt 2	2.33	LBAI/GALFS	3.37	FLOZ/CWT	117394	128938	53.9	61.3
	ILEVO	5	LBAI/GALFS	1.2	FLOZ/CWT				
7	Trt 2	2.33	LBAI/GALFS	3.37	FLOZ/CWT	118265	126905	53.9	65.1
	ILEVO	5	LBAI/GALFS	1.2	FLOZ/CWT				
	AVEO EZ (MINIMUM 61 BCFU/ML)	115.6	BCFU/mL FS	0.2	FLOZ/CWT				
8	NIPSIT INSIDE IN	5	LBAI/GALFS	1.28	FLOZ/CWT	118265	129228	54.3	64.4
	EXP1		LBAI/GALFS		FLOZ/CWT				
	EXP2		LBAI/GALFS		FLOZ/CWT				
	AVEO EZ (MINIMUM 61 BCFU/ML)	115.6	BCFU/mL FS	0.2	FLOZ/CWT				
					P > F	0.5641	0.7954	0.9199	0.3683
					CV%	10.8	6.4	1.3	7.1

Soybean (*Glycine max)*
Rhizoctonia root rot *(Rhizoctonia solani)*

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Effect of in-furrow application of Actigard 50 WG on Rhizoctonia root rot disease severity and yield of soybean, 2018.

In 2018, a trial was conducted at the CSREC in Urbana, IL testing the effects of Acitgard 50 WG (Acibenzolar-S-methyl) applied in-furrow on *Rhizoctonia solani* on soybean. This trial was planted using an Almaco 360 research plot planter on 5/29/18. Planting population was 140000 ppa and the variety was NK S30-V6. The plot size was four (30") rows wide by 20 feet long. The experimental design was a randomized complete block design with four replications. In-furrow applications were applied at planting using CO2 charged applicator mounted to the planter. Treatments we applied between the furrow openers and the closing wheels of the planter in the seed furrow at a rate of two GPA. Plots were inoculated with sterile sorghum infested with *Rhizoctonia solani* at a rate of 1 gram per foot of row. Stand counts were taken 2 weeks after planting and root ratings for Rhizoctonia disease severity were taken 3 weeks after planting. Plots were harvested using a Massey 8XP research plot combine. Yields were calculated based on a 60 lb. bushel weight and adjusted to 13.5% moisture. Data were analyzed by ANOVA and Fisher's LSD at $P \leq 0.05$ was calculated for mean comparisons.

There were no significant differences between Actigard, Xanthion, and the untreated control with respect to plant population. Neither Xanthiun, not any Actigard treatment significantly reduced root rot ratings. Actigard treatments resulted in greater plant heights ($P < 0.1$) compared to untreated controls at all rates tested, but did not differ from Xanthion. Actigard applied between 0.25 and 1 oz. / A increased plant weights compared to untreated controls, but not Xanthion. No differences in yield were detected.

Table 1. Effect of Actigard applied in-furrow on soybean population, disease severity of Rhizoctonia and yield.

Treatment	plants/A Population	Rating AVE	Height Ave	Per Plant Weight	% Moisture	bu/A Yield
Untreated control	109553	2.0	12.9	0.9	14.2	56.5
Actigard 0.25 oz./A	120226	1.0	15.3	1.7	14.6	61.5
Actigard 0.5 oz./A	115216	0.9	15.3	1.6	15.1	63.0
Actigard 1 oz. / A	109771	0.9	15.7	1.7	14.2	61.4
Actigard 2 oz. / A	112167	1.3	14.4	1.1	13.9	59.4
Xanthion A@2.4 oz./A + B@12 oz./A	112603	1.1	14.2	1.3	14.7	61.1
P > F	0.6883	0.7723	**0.0746**	**0.0565**	0.164	0.6699
LSD 0.05	n.s.	n.s.	**1.9**	**0.5**	n.s.	n.s.
CV%	8.9	97	**8.9**	**25**	4.3	9.1

Soybean (*Glycine max)*

White mold *(Sclerotinia sclerotorium)*
Brown spot (*Septoria glycines*)

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Effect of foliar fungicide on phytotoxicity and disease severity of white mold, brown spot, and yield of soybean, 2018.

Research plots were planted at the former Northern Illinois Agronomy Research center near Dekalb, IL in 2018 to study the effects of foliar fungicides on the disease severity of *Sclerotinia sclerotiorum*, commonly known as white mold of soybeans. This trial was planted using an Almaco research plot drill on 5/8/18. Plots were planted into 7.5" row spacing and planted at a population 140000 ppa. The variety was NK S30-V6. The plot size was seven (7.5") rows wide by 20 ft. long. The experimental design was a randomized complete block design with four replications. Fungicide applications were applied using a hand held 4-nozzle research sprayer. The sprayer was set at 40 PSI using XR 8002 nozzles and applied at 3 mph. This set up achieved an application rate of 20 gpa. The R1 applications were applied on 6/28/18 while the R3 treatments were applied on 7/12/18. Plots were inoculated with ground, sterile oats infested with *S. sclerotorium* on 6/29/18. Plots were harvested using a Massey 8XP research plot combine. Yields were calculated based on a 60 lb. bushel weight and adjusted to 13.5% moisture. Data were analyzed by ANOVA and Fisher's LSD at $P \leq 0.05$ was calculated for mean comparisons.

Phytotoxicity was seen after the R1 application and treatments were significantly higher than the untreated control. Plots treated with Cobra and Cadet had the highest phytotoxicity of any treatments. Soybean yield was also significantly affected by treatment, with Cobra significantly reducing yield relative to other treatments. Plots treated with Aproach Prima @ 9 fl oz./A at R1 followed by Aproach Prima @ 9 fl oz./A 12-14 days after had the highest yield at 99.6 bu/A. No white mold was evident in the trial this season, likely due to hot temperatures during flowering periods. Cross-referencing site data with Sporecaster (http://ipcm.wisc.edu/apps/sporecaster/) indicated an extremely low risk for white mold development, helping to validate this assumption.

Table 1. Effect of foliar fungicide on disease severity of white mold and soybean yield.

Company	Treatment Name	*Rate	Growth Stage	R3-- 7/12/2018 % Mid Canopy PhytoTox	Septoria % Defoliation	lbs./bu Test Weight	adj to 13% bu/A Yield
	Uninoculated Untreated			0.0	21.3	54.5	95.0
	Inoculated Untreated			0.0	20.0	54.5	95.6
Syngenta	Domark	4.00	R1	0.0	18.8	54.5	93.7
	NIS	0.250	R1				
Syngenta	Aproach	9.00	R1	0.0	20.0	54.8	93.5
	NIS	0.250	R1				
Syngenta	Miravis Top	13.7	R1	3.8	20.0	54.6	94.3
	NIS	0.250	R1				
Syngenta	Miravis Neo	13.7	R1	0.0	18.8	54.7	90.6
	NIS	0.250	R1				
Syngenta	Miravis Neo	20.8	R1	2.5	17.5	54.6	88.6
	NIS	0.250	R1				
Syngenta	Miravis Neo	13.70	R3	0.0	21.3	54.5	94.3
	NIS	0.250	R3				
Syngenta	Miravis Neo	20.80	R3	0.0	18.8	54.6	95.3
	NIS	0.250	R3				
Syngenta	Miravis Neo	13.70	R1	11.3	22.5	54.8	94.4
	NIS	0.250	R1				
Bayer	Proline	3.00	R1	0.0	17.5	54.4	93.5
	NIS	0.13	R1				

Bayer	Delaro+	8.00	R1				
	NIS	0.13	R1	5.0	18.8	54.7	97.1
Bayer	Delaro	8.00	R1				
	NIS FB	0.13	R1 FB				
	Delaro	8.00	R3				
	NIS	0.13	R3	0.0	12.5	54.6	98.2
Bayer	Propulse	6.00	R1				
	NIS FB	0.13	R1 FB				
	Delaro	8.00	R3				
	NIS	0.13	R3	5.0	21.3	54.4	96.9
Valent	Cobra	6.00	R1				
	COC	1.00	R1	75.0	10.0	54.9	83.0
	Domark +	4.00	R1	0.0	21.3	54.7	92.9
	Priaxor	4.00	R1				
Corteva	Aproach	8.00	R1	0.0	21.3	54.7	96.1
Valent	Cadet	0.50	R1				
	COC	1.00	R1	31.3	15.0	54.5	93.3
Corteva	Aproach Prima FB	9.00	R1 FB				
	Aproach Prima	9.00	12-14 days after	0.0	20.0	54.8	99.6
Syngenta	Actigard	1.00	R1	0.0	22.5	54.8	94.9
	Actigard	1.00	R3	0.0	20.0	54.5	98.1
			P > F	**<.0001**	0.2074	0.9168	**0.0334**
			LSD 0.05	**9.7**	n.s.	n.s.	**7.3**

*Rate is listed as fl oz. /A for fungicides and percentage for adjuvants. FB = followed by.

Soybean (*Glycine max)*
Frogeye leaf spot; *Cercosproa sojina*

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Effect of foliar fungicide timing and row spacing on Frogeye leaf spot and yield of double crop soybean, 2018.

Trials were conducted at the CSREC in Urbana, IL and the Ewing Demonstration Center near Ewing, IL. Trials were planted using a Great Plains research no-till drill at Urbana and an Almaco research no-till drill at Ewing. All dates are listed in the table below (Table 1). The previous crop for both trials was wheat. The experimental design for both trials was a strip plot, with main plots (spacing) and sub plots (fungicide). Treatment combinations were replicated 4 times at each site, and arranged as a randomized complete block design. Both row spacing treatments were planted at 150000 ppa. Fungicide applications were applied using a hand held 4-nozzle research sprayer. The sprayer was set at 40 PSI using XR 8002 nozzles and applied at 3 mph. This set up achieved an application rate of 20 gpa. Priaxor fungicide (four fl oz. / A) was applied at either the R1 and R3 growth stage. Stand counts were taken approx. 30 DAP. Disease evaluations were taken approx. 7-10 DAA and every 7-10 days after that until plants began to senesce. Plots were harvested in Urbana using a Massey 8XP research plot combine and in Ewing using an Almaco research plot combine. Data were analyzed by ANOVA and Fisher's LSD at $P \leq 0.05$ was calculated for mean comparisons. Yields were calculated based on a 60 lb. bushel weight and adjusted to 13.5% moisture.

Frogeye leaf spot severity was not affected by row spacing at either location or date of disease rating (Tables 3, 6). Plant population was affected by row spacing at both locations, but it is believed that planter setup was the cause of the difference in population (Tables 3, 6). Row spacing did significantly affect yield at Urbana. FLS severity was affected by application timing at every rating date at both locations (Tables 4, 7). Although not significant, application timing did increase yield at both the R1 and R3 timings in Urbana and Ewing.

Table 1. List of dates.

Location	Planting Date	Stand Count Date	R1 Application Date	R3 Application Date	Disease Rating Date	Harvest Date
Urbana, IL	7/4/18	8/9/18	8/17/18	9/4/18	9/13/18, 9/21/18, 10/8/18	11/8/18
Ewing, IL	7/10/18	8/10/18	8/23/18	9/11/18	9/11/18, 9/25/18, 10/2/18, 10/8/18	10/30/18

Table 2. Effect of row spacing and fungicide application timing on population, FLS severity and yield of soybean at Urbana, IL.

							10/8/2018	
			8/9/2018	9/13/2018	9/21/2018	10/8/2018	Green	bu/A
	inches		plnts/A	FLS	FLS	FLS	Seeker	Adj to 13%
Treatment	**Row Spacing**	**Timing**	**Population**	**AVE**	**AVE**	**AVE**	**AVE**	**Yield**
1	15	Untreated	115870	2.8	4.0	4.3	0.71	33.1
2	7.5	Untreated	167270	3.0	3.7	4.0	0.71	29.6
3	7.5	R1	166109	3.0	3.0	3.3	0.72	29.5
4	15	R1	115434	2.5	2.5	2.8	0.75	38.0
5	7.5	R3	170755	1.0	1.5	2.0	0.73	35.3
6	15	R3	115870	1.0	1.2	2.0	0.73	36.3
		P > F	**0.0024**	**0.0011**	**0.0099**	**0.0008**	0.4714	0.1207
		LSD 0.05	**32148**	**0.95**	**1.5**	**0.95**	n.s.	7
		CV%	**13.4**	**23.9**	**32.5**	**17.5**	4.2	11.8

Table 3. Effect of row spacing on population, FLS severity and yield of soybean at Urbana, IL.

					10/8/2018	
	8/9/2018	**9/13/2018**	**9/21/2018**	**10/8/2018**	**Green**	**bu/A**
inches	**plnts/A**	**FLS**	**FLS**	**FLS**	**Seeker**	**Adj to 13%**
Row Spacing	**Population**	**AVE**	**AVE**	**AVE**	**AVE**	**Yield**
7.5	167706	2.5	2.9	3.3	0.72	30.9
15	115724	2.1	2.6	3.0	0.73	35.7
P > F	**<.0001**	0.0998	0.4261	0.3323	0.3462	**0.0203**
LSD 0.05	**16586**	n.s.	n.s.	n.s.	n.s.	**3.9**
CV%	**12.3**	23	31	17.5	4	**11.7**

Table 4. Effect of fungicide application on population, FLS severity and yield of soybean at Urbana, IL.

					10/8/2018	
	8/9/2018	**9/13/2018**	**9/21/2018**	**10/8/2018**	**Green**	**bu/A**
	plnts/A	**FLS**	**FLS**	**FLS**	**Seeker**	**Adj to 13%**
Timing	**Population**	**AVE**	**AVE**	**AVE**	**AVE**	**Yield**
Untreated	137899	2.8	3.8	4.1	0.71	31.6
R1	137152	2.7	2.7	3.0	0.74	34.4
R3	134165	1.0	1.3	2.0	0.73	35.9
P > F	0.9877	**<.0001**	**0.0007**	**<.0001**	0.2311	0.3098
LSD 0.05	n.s.	**0.6**	**1**	**0.6**	n.s.	n.s.
CV%	12.3	**23**	**31**	**17.5**	4	11.7

Table 5. Effect of row spacing and fungicide application timing on population, FLS severity and yield of soybeans at Ewing, IL.

							10/2/18		10/8/18	
				9/11/18	9/25/18	10/2/18	Green	10/8/18	Green	bu/A
	inches		8/10/18	FLS	FLS	FLS	Seeker	FLS	Seeker	Adj to 13%
Trt	Row Spacing	Timing	Plnts/A Population	AVE	AVE	AVE	AVE	AVE	AVE	Yield
1	15	Untreated	96268	3.0	15.8	18.8	0.87	21.3	0.76	39.7
2	7.5	Untreated	239580	2.0	16.3	18.4	0.87	20.0	0.77	39.1
3	7.5	R1	163786	1.4	8.8	10.5	0.87	11.3	0.78	44.0
4	15	R1	105415	1.2	6.3	7.8	0.88	9.8	0.79	40.2
5	7.5	R3	175982	2.9	5.0	5.0	0.87	8.5	0.79	41.4
6	15	R3	108464	3.2	5.0	5.2	0.87	8.5	0.78	41.2
		P > F	**<.0001**	**0.0014**	**<.0001**	**<.0001**	0.284	**<.0001**	0.4987	0.411
		LSD 0.05	**48056**	**0.98**	**3.4**	**3.5**	n.s.	**4.3**	n.s.	n.s.
		CV%	**21.5**	**29**	**24**	**21**	0.9	**21.5**	80	8.3

Table 6. Effect of row spacing on population, FLS severity and yield of soybean at Ewing, IL.

					10/2/2018		10/8/2018	
		9/11/2018	9/25/2018	10/2/2018	Green	10/8/2018	Green	bu/A
inches	8/10/2018	FLS	FLS	FLS	Seeker	FLS	Seeker	Adj to 13%
Row Spacing	Population	AVE	AVE	AVE	AVE	AVE	AVE	Yield
7.5	193116	2.1	10.0	11.3	0.87	13.3	0.78	41.5
15	103382	2.5	9.0	10.6	0.87	13.2	0.78	40.3
P > F	**<.0001**	0.1848	0.2935	0.4372	0.4403	0.9417	0.8284	0.447
LSD 0.05	**32326**	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
CV%	**25**	30	23	21	0.89	21	5.9	8.4

Table 7. Effect of fungicide application on population, FLS severity and yield of soybean at Ewing, IL.

					10/2/2018		10/8/2018	
		9/11/2018	9/25/2018	10/2/2018	Green	10/8/2018	Green	bu/A
	8/10/2018	FLS	FLS	FLS	Seeker	FLS	Seeker	Adj to 13%
Timing	**Population**	**AVE**	**AVE**	**AVE**	**AVE**	**AVE**	**AVE**	**Yield**
Untreated	167924	2.5	16.0	18.5	0.87	20.6	0.77	39.3
R1	134600	1.3	7.5	9.1	0.87	10.5	0.79	42.4
R3	142223	3.0	5.0	5.1	0.87	8.5	0.79	41.3
P > F	0.2068	**0.0003**	**<.0001**	**<.0001**	0.0954	**<.0001**	0.5782	0.3264
LSD 0.05	n.s.	**0.72**	**2.3**	**2.4**	n.s.	**2.9**	n.s.	n.s.
CV%	25	**30**	**23**	**21**	0.89	**21**	5.9	8.4

Wheat (*Triticum aestivum)*
Head Blight (Scab) *(Fusarium graminearum)*

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Effect of foliar fungicide on disease severity of head blight (*Fusarium graminearium*) and yield of wheat, 2018.

Research plots were planted at the Crop Sciences Research and Education Center near Urbana, IL in 2018 to study the effects of foliar fungicides on the disease severity of Fusarium Head blight on wheat, commonly known as head scab of wheat. This trial was planted using Great Plains no-till research plot drill on 10/2/17. Plots were planted into 7.5" row spacing and planted at a population 1.2 million ppa. The previous crop was soybean and conventional tillage was done before planting. Sorghum grain infested with aggressive isolates of *F. graminearum* were broadcast across plots at a rate of 500 ml grain / plot on 5/12/18. The variety was Stone 31W04. The plot size was seven (7.5") rows wide by 20 ft. long. The experimental design was a randomized complete block design with four replications. Fungicide applications were applied using a hand held 4-nozzle research sprayer. The sprayer was set at 40 PSI using XR 8002 nozzles and applied at 3 mph. This set up achieved an application rate of 20 gpa. The Feekes 8/9 applications were applied on 5/11/18, the Feekes 10.5 applications were applied on 5/17/18, the Feekes 10.5.1 applications were applied on 5/21/18 and the Feekes 10.5.1 + 5 days were applied on 5/25/18. Plots were inoculated with sterile sorghum infested with Fusarium graminearium on 5/9/18. Head blight severity was rated by counting the total number of symptomatic heads per plot and dividing by the total number of heads per plot. The percent lodging was assessed visually. A handheld greenseeker was used to acquire NDVI measurements on 6/5 and 6/14/18. Plots were harvested using a Massey 8XP research plot combine. Data were analyzed by ANOVA and Fisher's LSD at $P \leq 0.05$ was calculated for mean comparisons. Yields were calculated based on a 60 lb. bushel weight and adjusted to 13.5% moisture.

Disease pressure for Fusarium head blight for this trial and region of Illinois was minimal, likely due to a pronounced hot, dry period occurring just prior and through flowering. Severe winds also resulted in significant lodging across sections of the study. Fungicide treatment did not have a significant effect on disease severity or yield for this trial. Treatment was significant for test weight, with most fungicide applications reducing test weights compared to the untreated control. Greenseeker NDVI's were greater for all Miravis ACE treatments on 6/14/18 compared to untreated controls, indicating delayed senescence. Lodging likely confounded yield data for this trial.

Table 1. Effect of foliar fungicide on Fusarium head blight and yield of wheat. .

Treatment Name	Feekes Timing	Product Rate	Unit	6/5/2018 Green Seeker	6/14/2018 Green Seeker	6/14/2018 Ave % Lodging	heads/ sq. ft. FHB Average	lbs./bu Test Weight	adj to 13.5% Bu/A Yield
Control				0.66	0.41	0.0	0.2	60.0	96.0
Absolute Maxx	9	5	fl oz./A	0.67	0.48	0.0	0.8	57.9	91.2
NIS		0.125	%v/v						
Prosaro	10.5.1	6.5	fl oz./A	0.68	0.44	0.0	0.2	57.8	92.9
NIS		0.125	%v/v						
Miravis Ace	10.5	13.7	fl oz./A	0.70	0.53	0.0	0.0	59.2	101.8
NIS		0.25	%v/v						
Miravis Ace	10.5.1	13.7	fl oz./A	0.70	0.51	0.0	0.1	61.1	94.3
NIS		0.25	%v/v						
Trivapro	8	9.4	fl oz./A	0.69	0.44	13.1	0.5	56.8	91.4
NIS		0.125	%v/v						
Trivapro	10.5	13.7	fl oz./A	0.67	0.46	5.6	0.3	58.9	95.3
NIS		0.125	%v/v						
Trivapro	8	9.4	fl oz./A						
NIS		0.125	%v/v						
Miravis Ace	10.5.1	13.7	fl oz./A						
NIS		0.125	%v/v						
Miravis Ace	10.5.1 + 5 days	13.7	fl oz./A						
NIS		0.125	%v/v	0.69	0.52	6.9	0.2	60.7	99.0
Trivapro	8	9.4	fl oz./A						
NIS		0.125	%v/v						
Miravis Ace	10.5.1 + 5 days	13.7	fl oz./A						
NIS		0.125	%v/v	0.70	0.55	16.9	0.2	58.9	96.2

Priaxor	8	4	fl oz./A	0.70	0.48	0.0	0.5	57.2	101.8
NIS		0.125	%v/v						
Priaxor	10.5	4	fl oz./A	0.72	0.53	18.8	0.3	58.9	101.4
NIS		0.125	%v/v						
Priaxor	8	4	fl oz./A						
NIS	8	0.125	%v/v						
Caramba	10.5.1	10	fl oz./A						
NIS		0.125	%v/v						
Caramba	10.5.1 + 5 days	10	fl oz./A	0.69	0.48	0.0	0.1	56.7	98.6
NIS		0.125	%v/v						
Stratego YLD	8	4	fl oz./A	0.67	0.48	0.0	0.4	57.3	94.9
NIS		0.125	%v/v						
Stratego YLD	10.5	4	fl oz./A	0.69	0.49	0.0	0.3	57.6	101.2
NIS		0.125	%v/v						
Stratego YLD	8	4	fl oz./A						
NIS		0.125	%v/v						
Prosaro	10.5.1	6.5	fl oz./A						
NIS		0.125	%v/v						
Prosaro	10.5.1 + 5 days	6.5	fl oz./A	0.68	0.46	0.0	0.7	58.9	93.2
NIS		0.125	%v/v						
			P > F	0.4078	**0.0165**	0.1236	0.1627	**0.0491**	0.1757
			LSD 0.05	n.s.	**0.07**	n.s.	n.s.	**2.8**	n.s.
			CV%	3.9	**10.3**	262	130	**3.3**	6.5

2018 Statewide Corn and Soybean Insect Survey Summary

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The Illinois Statewide Corn and Soybean Insect Survey has occurred in seven of the last eight years (2011, 2013–2018). These surveys have been conducted with the goal of estimating densities of common insect pests. In 2018, 40 counties representing all nine crop reporting districts were surveyed, with five corn and five soybean fields surveyed in each county.

Within the soybean fields surveyed, 100 sweeps were performed on both the exterior of the field (outer 2 rows) and interior (at least 12 rows beyond the field edge) using a 38-cm diameter sweep net. The insects collected in sweep samples were identified and counted to provide an estimate of the number of insects per 100 sweeps (Tables 1 and 2).

Japanese beetle populations were higher statewide in 2018 compared to 2017. Western Illinois saw record numbers in 2017 and populations stayed high in 2018. The highest Japanese beetle populations remained in western Illinois, but numbers increased dramatically in the northwest. As we have seen repeatedly over the years, grape colaspis populations are highly variable. Despite having reports of sporadic larval injury in the spring, adult populations were lower in 2018 compared to 2017. We did see more stinkbugs as well as green cloverworm and soybean loopers statewide. While the majority of the stink bugs collected were green stink bugs and brown stinkbugs, we did not find any of the southern species like redbanded and red-shouldered stink bugs in the survey. Brown marmorated stink bug was found for the first time in soybean field sweeps in several counties.

Western corn rootworms populations have been very low in recent years. In addition to sweep samples in soybeans, cornfields were sampled for western corn rootworm by counting the number of beetles on 20 consecutive plants beyond the end rows of a given field—a beetle per plant average was calculated for each field. A mild winter followed by favorable conditions at egg hatch and adult emergence helped the small populations from 2016 gain some traction in 2017 (Table 3). However, per plant averages were lower in all districts again in 2018.

Table 1. Average number of insects per 100 sweeps on the edge of the field.

District	Bean Leaf Beetle	Grape Colaspis	Japanese Beetle	Northern CRW	Southern CRW	Western CRW	Grasshopper	Cloverworm/ Loopers	BMSB	Other Stink Bugs
Northwest	3.00	12.10	175.70	7.50	0.10	0.50	0.70	0.20	0.00	0.50
Northeast	3.44	1.08	36.46	26.56	1.04	5.30	1.72	0.44	0.00	0.40
West	1.00	2.00	151.70	4.20	2.00	0.00	1.10	1.00	0.20	0.40
Central	4.40	4.10	30.60	1.90	1.70	1.60	2.00	0.95	0.00	0.20
East	8.00	2.04	25.44	0.08	0.64	5.72	4.52	4.04	0.08	0.24
West Southwest	2.48	10.08	85.34	1.04	3.52	0.72	2.68	2.64	0.00	0.86
East Southeast	5.65	4.25	27.53	0.65	1.40	0.00	1.20	7.90	0.00	2.48
Southwest	0.40	4.33	11.95	1.60	2.83	0.10	1.93	1.08	0.20	0.65
Southeast	0.96	8.16	12.96	0.80	1.84	0.00	4.80	6.88	0.08	1.20
2018 State AVERAGE	**3.29**	**4.50**	**47.75**	**4.60**	**1.87**	**1.68**	**2.49**	**3.12**	**0.07**	**0.80**
2017 State AVERAGE	**2.38**	**8.25**	**28.83**	**0.31**	**0.82**	**1.29**	**2.58**	**0.69**	**0.00**	**0.22**

Table 2. Average number of insects per 100 sweeps in the interior of the field.

District	Bean Leaf Beetle	Grape Colaspis	Japanese Beetle	Northern CRW	Southern CRW	Western CRW	Grasshopper	Clvoerworm /Looper	BMSB	Other Stink Bugs
Northwest	1.20	0.30	127.90	17.50	0.00	0.90	9.70	0.00	0.20	0.35
Northeast	4.43	0.13	20.07	2.90	0.87	0.13	2.63	0.83	0.00	0.37
West	0.53	0.55	144.10	2.63	2.78	0.00	2.90	0.45	0.00	0.85
Central	2.70	1.80	36.10	2.60	1.00	0.10	1.80	2.40	0.30	0.60
East	8.36	1.12	12.00	0.00	1.04	4.36	3.84	3.02	0.08	0.38
West Southwest	4.18	4.26	78.30	0.16	2.82	0.48	2.60	4.46	0.00	1.20
East Southeast	5.70	4.20	18.13	0.13	1.63	0.00	2.43	9.45	0.13	1.00
Southwest	0.80	10.38	8.78	0.00	3.98	0.00	0.75	2.18	0.00	0.48
Southeast	0.40	6.72	20.16	0.32	2.32	0.08	3.04	12.72	0.16	0.70
2018 State AVERAGE	**3.39**	**3.64**	**42.20**	**1.09**	**2.05**	**0.64**	**2.50**	**4.44**	**0.08**	**0.70**
2017 State AVERAGE	**4.42**	**12.73**	**51.27**	**0.21**	**0.99**	**0.28**	**4.03**	**0.60**	**0.00**	**0.17**

Table 3. Mean number of western corn rootworm beetles per plant in corn by crop reporting district and year.

District	2011	2013	2014	2015	2016	2017	2018
Northwest	0.26	0.33	0.05	0.02	0.02	0.10	0.04
Northeast	0.15	0.20	0.02	0.00	0.02	1.95	0.35
West	0.01	0.10	0.01	0.01	0.00	0.75	0.00
Central	0.35	0.37	0.74	0.02	0.05	0.30	0.12
East	0.31	0.81	0.51	0.01	0.01	0.40	0.02
West-southwest	0.01	0.20	0.06	0.00	0.01	0.70	0.35
East-southeast	0.02	0.01	0.00	0.00	0.00	0.00	0.03
Southwest	0.00	0.00	0.00	0.01	0.01	0.15	0.00
Southeast	0.00	0.03	0.01	0.00	0.02	0.20	0.03
STATE AVE	**0.12**	**0.23**	**0.16**	**0.01**	**0.01**	**0.51**	**0.11**

Means were determined by counting the number of beetles on 20 consecutive plants for between 15 and 50 fields per district.

Funding: USDA National Institute of Food and Agriculture.

Acknowledgements: This survey would not be possible without the hard work and contributions of many people, including Cooperative Agriculture Pest Survey Program interns Evan Cropek, Hannah Hires, Calli Robinson, and Cale Sementi as well as Department of Crop Science intern Matt Mote.

Insecticides for Control of Japanese Beetles in Soybean, 2018

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Location: Northwestern Illinois Agricultural Research and Demonstration Center, Monmouth, IL (40.929928, -90.719905)

Objective: To evaluate the performance of conventional insecticides for control of Japanese beetle (*Popillia japonica*) in soybean.

Materials and Methods: A field experiment was established in a randomized complete block design with four replicate blocks and eight treatments. The experimental units were plots of soybean (Table 1) that were 10 feet wide and 40 feet long, with 5 feet of unsprayed border separating plots on all sides. The eight treatments were different rate combinations of conventional insecticides. All applications were made at beginning pod formation (R3, 3 July 2018). Population densities of Japanese beetles were assessed on 6 July, 11 July, and 18 July 2018 by taking 10 sweeps per plot using a 15-inch diameter sweep net swung perpendicular to the rows through the soybean canopy. Plots were harvested on 18 October 2018 using a small plot combine with built-in yield monitor and moisture meter. Plots 405-408 were lost during harvest.

Data Analysis. Weights per plot were corrected to 13% moisture, and then converted to bushels per acre using the standard soybean bushel weight of 60 pounds. Japanese beetles per 10 sweeps at each sampling date and yields were subjected to analysis of variance (ANOVA) separately using a general linear model where replicate block and treatment were each considered as fixed effects. Japanese beetles per 10 sweeps on 6 July, 11 July, and 18 July were transformed prior to analysis to meet the assumptions of ANOVA. All transformations and data analyses were performed using ARM 2018 software (Gylling Data Management Inc., Brookings, SD).

Summary: All insecticides tested provided good initial control of Japanese beetles, with treated plots averaging less than one beetle per 10 sweeps at 3 days post-application. Higher rates of Endigo ZC and Endigo ZCX, Hero, and Warrior provided better control than Brigade 2EC at 8 days post-application. By 15 days post-application, all insecticide treatments had Japanese beetle population densities that were at least equivalent to the untreated controls, and Endigo ZC and Endigo ZCX had higher beetle densities than the untreated plots. No visual differences in defoliation level were observed among the plots, and there were no differences in yield among the treatments.

Funding: Project funding, Endigo ZC, Endigo ZCX, and Warrior II were provided by Syngenta Crop Protection, Greensboro, NC. Brigade 2EC and Hero were provided by FMC Corporation, Philadelphia, PA.

Acknowledgements: We thank Marty Johnson and Greg Steckel for planting, maintaining, and harvesting plots, and University of Illinois undergraduate students Alec Higgason and Victoria Newman for assisting with plot maintenance and data collection.

Table 1. Plot information.

Soybean variety	P28T08R (DuPont Pioneer, Johnston, IA)
Previous crop	Oats
Soil type	Osco silt loam
Tillage	Conventional (fall chisel, spring field cultivate)
Row spacing	15 inches
Seeding rate	150,000 seeds per acre
Planting date	8 May 2018
Herbicide	Pre-emerge: 10 May, Authority First (6.5 oz./a) + Dual II Magnum (1.67 pt./a) Post-emerge: 1 June, Roundup Weather Max (22 oz./a) + Warrant (1.5 qtr./a)
Treatment applications	10 gal/acre backpack, XR TeeJet 8001VS, 3 July 2018 (R3)

Table 2. Mean (± SE)[a] number of Japanese beetle adults per 10 sweeps and yields in bushels per acre at 13% moisture.

	Japanese beetle adults per 10 sweeps			Yield (bu/a)
Treatment	6 July (3 daa)[b]	11 July (8 daa)	18 July (15 daa)	18 October
Untreated (water-only)	27.8 ± 3.7 a	32.3 ± 7.5 a	10.8 ± 3.5 c	64.7 ± 1.9 a
Untreated (no spray)	22.0 ± 5.9 a	34.8 ± 3.7 a	13.0 ± 2.4 c	63.4 ± 3.2 a
Endigo ZC (4.5 oz./a)	0.3 ± 0.3 b	6.3 ± 2.8 c	40.0 ± 6.3 a	67.1 ± 1.8 a
Endigo ZCX (3.5 oz./a)	0.3 ± 0.3 b	9.8 ± 2.2 bc	29.3 ± 1.9 ab	65.1 ± 1.5 a
Endigo ZCX (4.5 oz./a)	0.0 ± 0.0 b	6.3 ± 0.9 c	30.5 ± 5.7 ab	63.9 ± 1.9 a
Brigade 2EC (4.0 oz./a)	0.3 ± 0.3 b	13.8 ± 2.5 b	18.8 ± 2.3 bc	63.3 ± 1.2 a
Hero (7.0 oz./a)	0.0 ± 0.0 b	5.3 ± 0.6 c	16.8 ± 3.8 c	65.1 ± 1.1 a
Warrior II (1.92 oz./a)	0.0 ± 0.0 b	6.3 ± 1.3 c	17.8 ± 4.4 c	64.7 ± 0.9 a

[a] All means and standard errors are reported without data transformations applied

[b] Days after treatment applications were made

[c] Means followed by the same letter within a column are not different based on the Fisher method of least significant difference (α = 0.05)

Table 3. Analysis of variance statistics. Analyses of Japanese beetle population densities had 31 total degrees of freedom (Replicate = three df, Treatment = seven df, Error = 21 df). Because yields were lost from four plots, yield had 27 total degrees of freedom (Replicate = 3 df, Treatment = 7 df, Error = 17 df).

		Replicate		Treatment	
Dependent variable	Date	*F*	*P*	*F*	*P*
Japanese beetle density	6 July[a]	1.92	0.157	67.31	< 0.001[b]
	11 July[a]	0.30	0.827	10.39	< 0.001[b]
	18 July[c]	0.96	0.431	6.36	< 0.001[b]
Yield	18 Oct.	2.04	0.147	0.51	0.816

[a] Data were transformed prior to analysis by taking the $\log_{10}$ of (x +1)

[b] Effect is significant at $\alpha = 0.05$

[c] Data were transformed prior to analysis by taking the square root of (x + 0.5)

Evaluations of insecticides and Bt hybrids for control of corn rootworm in Illinois, 2018

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Materials and Methods: Field experiments were established using randomized complete block designs, with four replicate blocks per experiment. The previous crop was a "trap crop" for corn rootworm beetles, which consisted of late-planted, non-Bt corn (seeding rate 22,000 seeds per acre) inter-seeded with sugar pumpkins (seeding rate 2 lbs. per acre). Treatments (3-13 per experiment) were different control tactics applied at planting, including in-furrow liquid and granular insecticides, insecticide seed treatments, and corn hybrids expressing different combinations of Bt traits. The experimental units were plots of corn that were 4 rows (10 ft.) wide and 30 ft., 40 ft., or 300 ft. in length depending on the experiment. Larval corn rootworm damage was rated in each plot during tasseling to blister stage (VT-R3) by digging 10 (large plot experiment) or 5 (all other experiments) root masses per plot from rows 1 and 2, removing all soil using an electric high-pressure water sprayer, and rating damage using the 0-3 Node-injury scale (Oleson et al. 2005). Percent root lodging (i.e., "goose-necking") was estimated for each plot at maturity (R6). In one large plot experiment, corn rootworm adult emergence was monitored using three "Illinois-style" emergence cages per plot, which were checked weekly. Yields were assessed for each plot by harvesting rows 3 and 4 using either a 4 row combine with a weigh-wagon (large plot experiment only) or a small-plot combine (Massey Ferguson 8XP, Kincaid Equipment, Haven, KS) with a built-in weight and moisture monitor (HarvestMaster, Logan, UT) (all other experiments).

Data Analysis. Percent consistency of root ratings for each plot was set equal to the percentage of roots that were assigned a node-injury rating of less than 0.25. Weights per plot were corrected to a standard weight at 15.5% moisture, then converted to bushels per acre using the standard bushel weight of 56 pounds. All dependent variables were subjected to analysis of variance (ANOVA) separately using a general linear model where replicate block and treatment were each considered as fixed effects. Data were transformed as needed prior to analysis to meet the assumptions of ANOVA. All transformations and analyses were performed using ARM 2018 software (Gylling Data Management Inc., Brookings, SD).

Acknowledgements: We thank Tim Lecher (Farm Manager) for assisting with planting and plot maintenance, Keith Ames for harvesting plots, and University of Illinois undergraduate students Alec Higgason and Victoria Newman for assisting with plot maintenance and data collection.

Evaluation of Poncho Votivo and Poncho Votivo 2.0 for Control of Corn Rootworm in Single-trait Bt Corn

Location: University of Illinois Agricultural and Biological Engineering Farm, Urbana, IL (40.070930, -88.213900)

Objective: To compare the performance of Poncho Votivo 2.0 and Poncho Votivo for control of corn rootworm (particularly western corn rootworm, *Diabrotica virgifera virgifera*) larval damage in a corn hybrid expressing the Cry3Bb1 (VT Triple PRO) insecticidal protein.

Summary: Larval corn rootworm pressure was sufficient to see a reduction in root injury in both Poncho Votivo and Poncho Votivo 2.0 compared with the untreated plots. However, there was no difference in root injury between plots treated with Poncho Votivo and Poncho Votivo 2.0. Yields were reduced in the untreated control compared with the Poncho Votivo treatment.

Funding: Project funding, seed, and pesticide materials for this trial were provided by Bayer CropSciences and BASF.

Table 1. Production information (plots 4 rows by 30 feet)

Corn hybrid	KSC[a] 6511 Genuity VT Triple PRO RIB complete
CRW proteins	Cry3Bb1
Seed coatings	Treatment-specific
Soil type	Thorp silt loam
Tillage	Conventional
Row spacing	30 inches
Seeding Rate	36,000 seeds per acre
Planting date	5 May 2018
Emergence date	13 May 2018
Herbicide	Post-emerge: 7 June, Callisto[b] (3 oz./a) and Roundup PowerMAX[c] (32 oz./a)

[a] Kitchen Seed Company Inc., Arthur, IL [b] Syngenta Crop Protection LLC, Greensboro, NC [c] Monsanto Company, St. Louis, MO

Table 2. Corn rootworm treatments

Trt	Seed treatment	Description
1	Untreated	Base fungicide only
2	Poncho Votivo[a]	1.25 mg clothianidin per seed + *Bacillus firmus* I-1582 + base fungicide
3	Poncho Votivo 2.0[a]	1.25 mg clothianidin per seed + *Bacillus firmus* I-1582 + *Bacillus thuringiensis* strain EX297512 + base fungicide

[a] Bayer Cropsciences, Research Triangle Park, NC (transferred to BASF)

Table 3. Mean (± SE)[a] node-injury ratings (0-3 scale) of corn rootworm larval feeding damage, percent consistency (percent of roots with a node-injury rating of < 0.25), percent root lodging ("goose-necking") per plot, and plot yields in bushels per acre at 15.5% moisture.

Treatment	Node-injury ratings 10 July (R1)	Percent consistency 10 July (R1)	Percent root lodging 30 Aug. (R6)	Corn yield, bushels per acre 21 Sept.
Untreated	1.83 ± 0.18 a[b]	0.0 ± 0.0 a	45.3 ± 0.9 a	190.1 ± 4.8 b
Poncho Votivo	0.57 ± 0.06 b	10.0 ± 5.8 a	0.0 ± 0.0 b	234.2 ± 8.9 a
Poncho Votivo 2.0	0.55 ± 0.10 b	20.0 ± 8.2 a	0.0 ± 0.0 b	210.6 ± 13.0 ab

[a] All means and standard errors are reported without data transformations applied

[b] Means followed by the same letter within a column are not different based on the Fisher method of least significant difference ($\alpha = 0.05$)

Table 4. Analysis of variance statistics. Each analysis had 11 total degrees of freedom (Replicate = 3 df, Treatment = 2 df, Error = 6 df)

Dependent Variable	Date	Replicate		Treatment	
		F	*P*	*F*	*P*
Root injury rating	10 July[b]	7.37	0.020[a]	39.35	< 0.001[a]
Percent consistency	10 July	2.50	0.157	4.50	0.064
Percent lodging	30 Aug.	1.00	0.455	8.14	0.020[a]
Yield	21 Sept.	1.31	0.355	5.84	0.039[a]

[a] Effect is significant at $\alpha = 0.05$

[b] Data were transformed prior to analysis by taking the Arcsine of $\sqrt{(x)}$

Liquid and Granular Soil Insecticides for Corn Rootworm Control In-furrow at Planting

Location: University of Illinois Agricultural and Biological Engineering Farm, Urbana, IL (40.070911, -88.214885)

Objective: To evaluate the performance of soil insecticides for control of western corn rootworm larval damage. Treatments included two rates of Ampex SC (clothianidin), two rates of Poncho seed-applied insecticide (clothianidin), and single rates of Force CS and Aztec 4.6G.

Summary: All insecticide materials that were tested reduced injury from corn rootworm feeding compared with the untreated control, but no distinctions among the different insecticides could be made. No differences in yield were observed

Funding: Project funding, seed, and pesticide materials for this trial were provided by Valent U.S.A. LLC (Walnut Creek, CA). Capture 3Rive 3D was provided by FMC Corporation.

Table 1. Plot information (plots 4 rows by 40 feet)

Corn hybrid	KSC[a] 6712
CRW proteins	None
Seed coatings	Maxim Quattro 0.064 mg ai/seed (base fungicide)
Soil type	Thorp silt loam
Tillage	Conventional
Row spacing	30 inches
Seeding Rate	36,000 seeds per acre
Planting date	8 May 2018
Emergence date	16 May 2018
Application Volume	
3RIVE unit	40 oz./acre (water)
In-furrow application	5 gal/acre (water)
Herbicide	Post-emerge: 7 June, Callisto[b] (3 oz./a) and Roundup PowerMAX[c] (32 oz./a)

[a] Kitchen Seed Company Inc., Arthur, IL [b] Syngenta Crop Protection LLC, Greensboro, NC [c] Monsanto Company, St. Louis, MO

Table 2. Corn rootworm treatments

Trt.	Insecticide	Active ingredient	Manufacturer
1	Untreated	N/a	N/a
2	Capture 3RIVE 3D (16 oz./a)	Bifenthrin	FMC Corporation
3	Force CS (9.9 oz./a)	Tefluthrin	Syngenta Crop Protection
4	Aztec 4.67G (52.3 oz./a)	Tebupirimphos + Cyfluthrin	AMVAC
5	Ampex SC (12 oz./a)	Clothianidin	Valent
6	Poncho (1.25 mg ai/seed)	Clothianidin	Bayer CropScience
7	Poncho (0.5 mg ai/seed)	Clothianidin	Bayer CropScience
8	Ampex SC (8 oz./a)	Clothianidin	Valent

Table 3. Mean (± SE)[a] node-injury ratings (0-3 scale) of corn rootworm larval feeding damage, percent consistency (percent of roots with a node-injury rating of < 0.25), percent root lodging ("goose-necking") per plot, and plot yields in bushels per acre at 15.5% moisture.

Treatment	Node-injury ratings 10 July (R1)	Percent consistency 10 July (R1)	Percent root lodging 30 Aug. (R6)	Corn yield, bushels per acre 21 Sept.
Untreated	1.07 ± 0.12 a[b]	5.0 ± 5.0 a	0.3 ± 0.3 a	188.4 ± 8.5 a
Capture 3RIVE 3D (16 oz./a)	0.37 ± 0.07 b	40.0 ± 16.3 a	0.0 ± 0.0 a	194.4 ± 5.9 a
Force CS (9.9 oz./a)	0.22 ± 0.05 b	55.0 ± 9.6 a	0.0 ± 0.0 a	200.3 ± 3.5 a
Aztec 4.67G (52.3 oz./a)	0.25 ± 0.06 b	60.0 ± 20.0 a	0.0 ± 0.0 a	209.7 ± 8.6 a
Ampex SC (12 oz./a)	0.15 ± 0.02 b	65.0 ± 12.6 a	0.0 ± 0.0 a	200.5 ± 1.4 a
Poncho 1.25 mg ai/seed	0.19 ± 0.03 b	55.0 ± 12.6 a	0.0 ± 0.0 a	220.8 ± 13.0 a
Poncho 0.5 mg ai/seed	0.31 ± 0.07 b	55.0 ± 22.2 a	0.0 ± 0.0 a	195.3 ± 12.1 a
Ampex SC (8 oz./a)	0.13 ± 0.01 b	80.0 ± 11.5 a	0.0 ± 0.0 a	205.5 ± 3.5 a

[a] All means and standard errors are reported without data transformations applied

[b] Means followed by the same letter within a column are not different based on the Fisher method of least significant difference ($\alpha = 0.05$)

Table 4. Analysis of variance statistics. Each analysis had 31 degrees of freedom (Replicate = 3 df; Treatment = 7 df; Error = 21 df).

		Replicate		Treatment	
Dependent variable	Date	*F*	*P*	*F*	*P*
Root injury rating	10 July[b]	0.09	0.965	7.42	< 0.001[a]
Percent consistency	10 July[b]	0.12	0.947	2.08	0.093
Percent lodging	30 Aug.	1.00	0.412	1.00	0.459
Yield	21 Sept.	1.75	0.187	2.14	0.083

[a] Effect is significant at $\alpha = 0.05$

[b] Data were transformed prior to analysis by taking the Arcsine of $\sqrt{(x)}$

Evaluation of Bt traits and soil insecticides for control of corn rootworm larvae

Location: University of Illinois Agricultural and Biological Engineering Farm, Urbana, IL (40.070902, -88.214245)

Objective: To compare the performance of Bt traits with and without soil insecticides for control of corn rootworm (particularly western corn rootworm, *Diabrotica virgifera virgifera*) larval damage.

Summary: Larval corn rootworm pressure was not sufficient to provide separation in root damage among these treatments. No differences were observed in yield or consistency.

Funding: Project funding was provided by Syngenta Crop Protection and AMVAC. Pesticide materials were provided by their respective manufacturers. Seed was provided by Monsanto.

Table 1. Plot information (plots 4 rows by 40 feet)

Soil type	Thorp silt loam
Tillage	Conventional
Row spacing	30 inches
Seeding Rate	36,000 seeds per acre
Liquid starter fertilizer	P-Max Plus 7-20-3[a], 5 gallons per acre (applied to all treatments and used as carrier for liquid insecticides)
Planting date	7 May 2018
Emergence date	15 May 2018
Insecticide seed trt.:	
DK 64-35	0.25 mg clothianidin per seed
DK 64-34	0.5 mg clothianidin per seed
G12W66	0.5 mg thiamethoxam per seed
Herbicide	Post-emerge: 7 June, Callisto[b] (3 oz./a) and Roundup PowerMAX[c] (32 oz./a)

[a] Rosen's, Inc., Fairmont, MN [b] Syngenta Crop Protection LLC, Greensboro, NC [c] Monsanto Company, St. Louis, MO

Table 2. Corn rootworm treatments

Trt.	Corn hybrid	Trait package	Corn rootworm protein	Soil Insecticide, Insecticide Seed Treatment
1	DK 64-35[a]	VT2 Pro RIB	None (“no Bt”)	None
2	DK 64-35	VT2 Pro RIB	None (“no Bt”)	Force Evo, 8 oz./a (24.2% tefluthrin)[b]
3	G12W66[c]	Agrisure 3000GT	mCry3A	none
4	G12W66	Agrisure 3000GT	mCry3A	Force Evo, 8 oz./a (24.2% tefluthrin)
5	DK 64-34[a]	SmartStax RIB	Cry3Bb1 + Cry34/35Ab1	none
6	DK 64-34	SmartStax RIB	Cry3Bb1 + Cry34/35Ab1	Force Evo, 8 oz./a (24.2% tefluthrin)
7	DK 64-35	VT2 Pro RIB	None (“no Bt”)	Force 6.5G, 2 lb./a (6.5% tefluthrin)[b]
8	DK 64-35	VT2 Pro RIB	None (“no Bt”)	AMV1118 CS-B[d]
9	DK 64-35	VT2 Pro RIB	None (“no Bt”)	Capture LFR, 17 oz./a (17.15% bifenthrin)[e]
10	DK 64-35	VT2 Pro RIB	None (“no Bt”)	Force 3G, 70 oz./a (3% tefluthrin)
11	DK 64-35	VT2 Pro RIB	None (“no Bt”)	Aztec 4.67G, 52.3 oz./a (4.45% tebupirimphos + 0.22% cyfluthrin)[d]
12	G12W66[c]	Agrisure 3122 EZ Refuge	mCry3A + Cry34/35Ab1	None
13	G12W66	Agrisure 3122 EZ Refuge	mCry3A + Cry34/35Ab1	Force Evo, 8 oz./a (24.2% tefluthrin)

[a] Dekalb, Monsanto Company, St. Louis, MO; [b] Syngenta Crop Protection LLC, Greensboro, NC; [c] Golden Harvest Seeds, Minnetonka, MN; [d] AMVAC Chemical Corporation, Los Angeles, CA; [e] FMC Corporation, Philadelphia, PA

Table 3. Mean (± SE)[a] node-injury ratings (0-3 scale) of corn rootworm larval feeding damage, percent consistency (percent of roots with a node-injury rating of < 0.25), and plot yields in bushels per acre at 15.5% moisture. No root lodging was observed.

Treatment	Node-injury ratings 12 July (R1)	Percent consistency 12 July (R1)	Corn yield, bushels per acre 21 Sept.
1) No Bt, no insecticide	0.09 ± 0.04 a[b]	85.0 ± 9.6 a	208.8 ± 8.8 a[b]
2) No Bt, Force Evo (8 oz./a)	0.04 ± 0.02 a	95.0 ± 5.0 a	222.6 ± 8.0 a
3) Agrisure 3000GT, no insecticide	0.05 ± 0.02 a	90.0 ± 10.0 a	210.8 ± 15.5 a
4) Agrisure 3000GT, Force Evo (8 oz./a)	0.04 ± 0.02 a	95.0 ± 5.0 a	205.2 ± 15.8 a
5) SmartStax RIB, no insecticide	0.02 ± 0.01 a	100.0 ± 0.0 a	201.9 ± 23.4 a
6) SmartStax RIB, Force Evo (8 oz./a)	0.01 ± 0.01 a	100.0 ± 0.0 a	207.7 ± 12.4 a
7) No Bt, Force 6.5G (32 oz./a)	0.12 ± 0.06 a	85.0 ± 9.6 a	199.4 ± 25.7 a
8) No Bt, AMV1118 CS-B (12.5 oz./a)	0.01 ± 0.01 a	100.0 ± 0.0 a	211.7 ± 10.8 a
9) No Bt, Capture LFR (17 fl oz./a)	0.08 ± 0.05 a	95.0 ± 5.0 a	208.8 ± 13.6 a
10) No Bt, Force 3G (70 oz./a)	0.04 ± 0.01 a	100.0 ± 0.0 a	199.9 ± 13.3 a
11) No Bt, Aztec 4.67G (52.3 oz./a)	0.02 ± 0.01 a	100.0 ± 0.0 a	208.2 ± 11.0 a
12) Agrisure 3122 EZ Refuge, no insecticide	0.04 ± 0.01 a	100.0 ± 0.0 a	212.3 ± 13.9 a
13) Agrisure 3122 EZ Refuge, Force Evo (8 oz./a)	0.01 ± 0.01 a	100.0 ± 0.0 a	217.0 ± 6.0 a

[a] All means and standard errors are reported without data transformations applied

[b] Means followed by the same letter within a column are not different based on the Fisher method of least significant difference ($\alpha = 0.05$)

Table 4. Analysis of variance statistics. Each analysis had 51 total degrees of freedom (Replicate = 3 df, Treatment = 12 df, Error = 36 df)

		Replicate		Treatment	
Dependent Variable	Date	*F*	*P*	*F*	*P*
Root injury rating	12 July	0.74	0.535	1.14	0.364
Percent consistency	12 July	1.00	0.404	1.19	0.329
Yield	21 Sept.	1.90	0.147	0.21	0.997

Evaluation of Two Formulations of Azadirachtin for Control of Corn Rootworm Larvae

Location: University of Illinois Agricultural and Biological Engineering Farm, Urbana, IL (40.070900, -88.215089)

Objective: To compare the performance of the azadirachtin products Neemazal and Avana with Force 3G for control of corn rootworm (particularly western corn rootworm, *Diabrotica virgifera virgifera*) larval damage.

Summary: Larval corn rootworm pressure was not sufficient to differentiate the insecticide treatments from the untreated control. An extended period of saturated soil conditions in June during rootworm egg hatch likely reduced populations to below damaging levels.

Funding: Project funding, Neemazal, and Avana were provided by Parry America (Arlington, TX). Force 3G was provided by Syngenta Crop Protection LLC (Greensboro, NC). Seed was provided by Dekalb (Monsanto Company, Chesterfield, MO).

Table 1. Plot information (plots 4 rows by 40 feet)

Corn hybrid	DKC 64-35 VT Double PRO RIB complete[a]
CRW proteins	None
Seed coatings	Acceleron B-300 SAT[b] (Clothianidin at 0.250 mg/seed)
Soil type	Thorp silt loam
Tillage	Conventional
Row spacing	30 inches
Seeding Rate	36,000 seeds per acre
Planting date	13 May 2018
Emergence date	20 May 2018
Liquid applications:	
T-Band liquid	5 gal/acre, 5-inch band at planting, 13 May 2018
V5 Broadcast	10 gal/acre backpack, XR TeeJet 8001VS, 5 June 2018
Herbicide	Post-emerge: 7 June, Callisto[c] (3 oz./a) and Roundup PowerMAX[b] (32 oz./a)

[a] Dekalb, Monsanto Company, St. Louis, MO [b] Monsanto Company, St. Louis, MO [c] Syngenta Crop Protection LLC, Greensboro, NC

Table 2. Insecticides

Insecticide material	Active ingredient	Manufacturer
Neemazal	Azadirachtin (emulsifiable concentrate)	Parry America, Inc.
Avana	Azadirachtin (granular)	Parry America, Inc.
Force 3G	Tefluthrin (granular)	Syngenta Crop Protection LLC

Table 3. Mean (± SE)[a] node-injury ratings (0-3 scale) of corn rootworm larval feeding damage, percent consistency (percent of roots with a node-injury rating of < 0.25), and plot yields in bushels per acre at 15.5% moisture. No root lodging was observed.

Treatment	Node-injury ratings 9 July (VT)	Percent consistency 9 July (VT)	Corn yield, bushels per acre 21 Sept.
Untreated	0.29 ± 0.06 a[b]	35.0 ± 15.0 a	209.7 ± 20.3 a
Neemazal (0.5pt/a) T-band	0.40 ± 0.06 a	25.0 ± 15.0 a	221.5 ± 8.2 a
Neemazal (1pt/a) T-band	0.38 ± 0.08 a	45.0 ± 9.6 a	218.1 ± 16.1 a
Neemazal (1.5pt/a) T-band	0.41 ± 0.07 a	20.0 ± 8.2 a	227.0 ± 5.0 a
Avana (4lb/a) in-furrow	0.30 ± 0.05 a	25.0 ± 9.6 a	206.6 ± 11.1 a
Avana (8lb/a) in-furrow	0.37 ± 0.07 a	45.0 ± 20.6 a	219.9 ± 8.0 a
Avana (12lb/a) in-furrow	0.54 ± 0.10 a	25.0 ± 5.0 a	226.5 ± 19.7 a
Avana (12lb/a) T-band	0.31 ± 0.05 a	30.0 ± 5.8 a	201.5 ± 19.4 a
Avana (8lb/a) in-furrow + Neemazal (1 pt./a) at V5	0.27 ± 0.05 a	40.0 ± 14.1 a	204.3 ± 10.9 a
Force 3G (4.4lb/a)	0.27 ± 0.06 a	40.0 ± 14.1 a	232.3 ± 6.9 a

[a] All means and standard errors are reported without data transformations applied

[b] Means followed by the same letter within a column are not different based on the Fisher method of least significant difference ($\alpha = 0.05$)

Table 4. Analysis of variance statistics. Each analysis had 39 total degrees of freedom (Replicate = 3 df, Treatment = 9 df, Error = 27 df)

Dependent Variable	Date	Replicate		Treatment	
		F	*P*	*F*	*P*
Root injury rating[a]	9 July	2.23	0.107	1.12	0.385
Percent consistency[a]	9 July	3.19	0.040[b]	0.58	0.805
Yield	21 Sept.	2.85	0.056	0.72	0.690

[a] Data were transformed prior to analysis by taking the Arcsine of $\sqrt{(x)}$

[b] Effect is significant at $\alpha = 0.05$

Evaluation of single and blended Bt traits for control of corn rootworm in a large plot experiment

Location: University of Illinois Agricultural and Biological Engineering Farm, Urbana, IL (40.070834, -88.215717)

Objective: To compare the performance of hybrids expressing mCry3A alone and in combination with Cry34/35Ab1 in large (4 rows by 300 feet) experimental plots

Summary: Larval corn rootworm pressure was not sufficient to provide separation in root damage or consistency among these treatments. No differences were observed in yield.

Funding: Seed for this trial was provided by Syngenta.

Table 1. Plot information (plots 4 rows by 300 feet)

Seed coatings	Avicta Complete 500 + Vibrance (0.5 mg thiamethoxam per seed)[a]
Previous crop	Trap crop: late-planted, non-Bt field corn inter-seeded with pumpkins
Soil type	Thorp silt loam
Tillage	Conventional
Row spacing	30 inches
Seeding Rate	36,000 seeds per acre
Planting date	17 May 2018
Emergence date	21 May 2018
Herbicide	Post-emerge: 7 June, Callisto[a] (3 oz./a) and Roundup PowerMAX[b] (32 oz./a)

[a] Syngenta Crop Protection LLC, Greensboro, NC [b] Monsanto Company, St. Louis, MO

Table 2. Corn rootworm treatments

Trt.	Corn rootworm protein	Corn Hybrid Family	Trait Package	Blended Refuge
1	No rootworm trait	G12W66[a]	GT	0%
2	mCry3A	G12W66	3000-GT	0%
3	mCry3A + Cry34/35Ab1	G12W66	3122-EZ1	5%

[a] Golden Harvest Seeds, Minnetonka, MN

Table 3. Mean (± SE)[a] node-injury ratings (0-3 scale) of corn rootworm larval feeding damage, percent consistency (percent of roots with a node-injury rating of < 0.25), total western corn rootworm adults collected per emergence cage, and plot yields in bushels per acre at 15.5% moisture. No root lodging was observed.

Treatment	Node-injury ratings 17 July (R3)	Percent consistency 17 July (R3)	Western corn rootworm emergence 20 June-30 Aug.	Corn yield, bushels per acre
No rootworm trait (GT)	0.24 ± 0.05 a[b]	55.0 ± 15.5 a	32.8 ± 7.1 a[b]	172.8 ± 8.4 a[b]
mCry3A (3000 GT)	0.13 ± 0.03 a	77.5 ± 7.5 a	25.5 ± 5.3 a	174.8 ± 5.3 a
mCry3A + Cry34/35AB1 (3122-EZ1)	0.10 ± 0.02 a	77.5 ± 8.5 a	13.8 ± 3.0 a	172.8 ± 3.3 a

[a] All means and standard errors are reported without data transformations applied

[b] Means followed by the same letter within a column are not different based on the Fisher method of least significant difference ($\alpha = 0.05$)

Table 4. Analysis of variance statistics. Each analysis had 11 total degrees of freedom (Replicate = 3 df, Treatment = 2 df, Error = 6 df)

		Replicate		Treatment	
Dependent Variable	Date	*F*	*P*	*F*	*P*
Root injury rating	17 July	0.37	0.777	2.37	0.174
Percent consistency	17 July[b]	0.45	0.729	1.13	0.383
Beetle emergence	Season total	0.92	0.485	2.10	0.203
Yield	21 Sept.	2.07	0.206	0.05	0.948

[a] Effect is significant at $\alpha = 0.05$

[b] Data were transformed prior to analysis by taking the Arcsine of $\sqrt{(x)}$

Evaluation of liquid in-furrow insecticides for control of corn rootworm

Location: University of Illinois Agricultural and Biological Engineering Farm, Urbana, IL (40.070905, -88.213936)

Objective: To compare the performance of commercial and pre-commercial liquid insecticide formulations for control of corn rootworm larvae

Summary: Larval corn rootworm damage was not sufficient to separate insecticide treatments based on node-injury rating, percent consistency, or percent lodging, and there were no difference in yield among treatments.

Funding: Project funding and pesticide materials for this trial were provided by FMC Corporation, Philadelphia, PA. Seed was provided by Monsanto Company, St. Louis, MO.

Table 1. Plot information (plots 4 rows by 40 feet)

Corn hybrid	DKC64-35 VT2[a]
Rootworm traits	None
Seed coatings	0.25 mg clothianidin per seed
Soil type	Thorp silt loam
Tillage	Conventional
Row spacing	30 inches
Seeding Rate	36,000 seeds per acre
Planting date	5 May 2018
Emergence date	13 May 2018
Liquid application	5 gallons water per acre in-furrow
Herbicide	Post-emerge: 7 June, Callisto[b] (3 oz./a) and Roundup PowerMAX[c] (32 oz./a)

[a] Dekalb, Monsanto Company, St. Louis, MO [b] Syngenta Crop Protection LLC, Greensboro, NC [c] Monsanto Company, St. Louis, MO

Table 2. Corn rootworm treatments

Trt.	Insecticide	Rate	Active ingredient
1	Coragen[a]	7.5 fl oz./a	Chlorantraniliprole
2	Coragen[a]	15 fl oz./a	Chlorantraniliprole
3	Verimark[a]	13.5 fl oz./a	Cyantraniliprole
4	Verimark[a]	20 fl oz./a	Cyantraniliprole
5	F4260-1[a]	3.45 fl oz./a	(pre-commercial)
6	F4260-1[a]	5.74 fl oz./a	(pre-commercial)
7	F4022-1[a]	8.5 fl oz./a	(pre-commercial)
8	F4274-3[a]	10.3 fl oz./a	(pre-commercial)
9	Ethos XB[a]	8.5 fl oz./a	Bifenthrin + *Bacillus amyloliquefaciens* strain D747
10	Capture LFR[a]	8.5 fl oz./a	Bifenthrin
11	Force 3G [b]	5 oz./a	Tefluthrin
12	Untreated		

[a] FMC Corporation, Philadelphia, PA [b] Syngenta Crop Protection LLC, Greensboro, NC

Table 3. Mean (± SE)[a] node-injury ratings (0-3 scale) of corn rootworm larval feeding damage, percent consistency (percent of roots with a node-injury rating of < 0.25), percent root lodging, and plot yields in bushels per acre at 15.5% moisture.

Treatment	Node-injury ratings 16 July (R2)	Percent consistency 16 July (R2)	Percent root lodging 30 Aug. (R6)	Corn yield, bushels per acre 21 Sept.
Coragen (7.5 fl oz./a)	0.21 ± 0.06 a[b]	60.0 ± 11.5 a	0.0 ± 0.0 a	208.1 ± 13.1 a
Coragen (15 fl oz./a)	0.47 ± 0.11 a	40.0 ± 16.3 a	0.0 ± 0.0 a	223.0 ± 4.1 a
Verimark (13.5 fl oz./a)	0.24 ± 0.07 a	60.0 ± 18.3 a	0.0 ± 0.0 a	210.0 ± 12.5 a
Verimark (20 fl oz./a)	0.39 ± 0.09 a	40.0 ± 14.1 a	0.0 ± 0.0 a	200.3 ± 12.5 a
F4260-1 (3.45 fl oz./a)	0.30 ± 0.09 a	55.0 ± 22.2 a	0.3 ± 0.3 a	205.6 ± 12.5 a
F4260-1 (5.74 fl oz./a)	0.27 ± 0.08 a	60.0 ± 0.0 a	0.0 ± 0.0 a	201.5 ± 12.3 a
F4022-1 (8.5 fl oz./a)	0.31 ± 0.08 a	55.0 ± 17.1 a	0.0 ± 0.0 a	189.0 ± 23.9 a
F4274-3 (10.3 fl oz./a)	0.24 ± 0.06 a	50.0 ± 10.0 a	0.0 ± 0.0 a	218.1 ± 11.4 a
Ethos XB (8.5 fl oz./a)	0.28 ± 0.06 a	40.0 ± 23.1 a	0.0 ± 0.0 a	201.6 ± 19.1 a
Capture LFR (8.5 fl oz./a)	0.11 ± 0.05 a	75.0 ± 9.6 a	0.0 ± 0.0 a	179.2 ± 15.0 a
Force 3G (5 oz./a)	0.09 ± 0.03 a	85.0 ± 5.0 a	0.0 ± 0.0 a	203.3 ± 10.4 a
Untreated	0.31 ± 0.08 a	45.0 ± 17.1 a	0.0 ± 0.0 a	208.0 ± 7.0 a

[a] All means and standard errors are reported without data transformations applied

[b] Means followed by the same letter within a column are not different based on the Fisher method of least significant difference ($\alpha = 0.05$)

Table 4. Analysis of variance statistics. Each analysis had 47 total degrees of freedom (Replicate = 3 df, Treatment = 11 df, Error = 33 df)

		Replicate		Treatment	
Dependent variable	Date	*F*	*P*	*F*	*P*
Stand	18 May	1.93	0.144	1.93	0.071
	29 May	2.04	0.127	2.10	0.050[a]
	4 June	1.37	0.270	1.43	0.207
	14 June	1.84	0.160	1.77	0.102
Height	4 June	3.06	0.042[a]	1.63	0.135
Root injury rating	16 July	1.72	0.182	0.84	0.608
Percent consistency	16 July	1.38	0.266	0.89	0.562
Percent lodging	30 Aug.	1.00	0.405	1.00	0.467
Yield	21 Sept.	1.15	0.344	0.73	0.699

[a] Effect is significant at $\alpha = 0.05$

Evaluation of 3RIVE insecticides for control of corn rootworm larval damage

Location: University of Illinois Agricultural and Biological Engineering Farm, Urbana, IL (40.070900, -88.214554)

Objective: To evaluate commercial and pre-commercial formulations of 3RIVE materials for control of corn rootworm larval damage, especially western corn rootworm (*Diabrotica virgifera virgifera*)

Summary: Larval corn rootworm damage was not sufficient to separate treatments, and no differences were observed in root injury, percent consistency, or yield.

Funding: Project funding and pesticide materials for this trial were provided by FMC Corporation, Philadelphia, PA. Seed was provided by Monsanto Company, St. Louis, MO.

Table 1. Plot information (plots 4 rows by 40 feet)

Corn hybrid	DKC64-35 VT Double Pro[a]
Corn rootworm trait	None
Seed coatings	0.25 mg clothianidin per seed
Previous crop	Trap crop: late-planted, non-Bt field corn inter-seeded with pumpkins
Soil type	Thorp silt loam
Tillage	Conventional
Row spacing	30 inches
Seeding Rate	36,000 seeds per acre
Planting date	8 May 2018
Emergence date	16 May 2018
Application	40 oz. water per acre, in-furrow
Herbicide	Post-emerge: 7 June, Callisto[b] (3 oz./a) and Roundup PowerMAX[c] (32 oz./a)

[a] Dekalb, Monsanto Company, St. Louis, MO [b] Syngenta Crop Protection LLC, Greensboro, NC [c] Monsanto Company, St. Louis, MO

Table 2. Corn rootworm treatments

Trt.	Material	Rate	Active ingredient
1	Untreated		
2	Capture 3RIVE 3D[a]	8 fl o z/a	Bifenthrin
3	Capture 3RIVE 3D	8 fl oz. /a	Bifenthrin
	+ F4278-3 3D[a]	6.66 fl oz./a	(pre-commercial)
4	F4278-3 3D	6.66 fl oz./a	(pre-commercial)
5	F4120-2 3D[a]	9.1 fl oz./a	(pre-commercial)
6	F4260-7 3RIVE 3D[a]	3.13 fl oz./a	(pre-commercial)
7	F4333-1 3D[a]	7.5 fl oz./a	(pre-commercial)
8	F4333-1 3D	15 fl oz./a	(pre-commercial)
9	F4334-1 3D[a]	13.5 fl oz./a	(pre-commercial)
10	F4334-1 3D	20 fl oz./a	(pre-commercial)
11	Capture 3RIVE 3D	8 fl oz./a	Bifenthrin
	+ F4333-1 3D	7.5 fl oz./a	(pre-commercial)
12	F9115-2[a]	12.8 fl oz./a	(pre-commercial)
13	Force 3G[b]	5 lb./a	Tefluthrin

[a] FMC Corporation, Philadelphia, PA; [b] Syngenta Crop Protection LLC, Greensboro, NC

Table 3. Mean (± SE)[a] node-injury ratings (0-3 scale) of corn rootworm larval feeding damage, percent consistency (percent of roots with a node-injury rating of < 0.25), and plot yields in bushels per acre at 15.5% moisture. No root lodging was observed.

Treatment	Node-injury ratings 17 July (R2)	Percent consistency (0.25) 17 July (R2)	Corn yield, bushels per acre 21 Sept.
Untreated	0.18 ± 0.05 a[b]	60.0 ± 11.5 a	221.4 ± 6.7 a
Capture 3RIVE 3D (8 oz./a)	0.09 ± 0.04 a	85.0 ± 5.0 a	216.6 ± 11.1 a
Capture 3RIVE 3D (8 oz./a) + F4278-3 3D (6.66 oz./a)	0.05 ± 0.02 a	90.0 ± 10.0 a	222.4 ± 6.7 a
F4278-3 3D (6.66 oz./a)	0.11 ± 0.03 a	65.0 ± 15.0 a	225.0 ± 17.7 a
F4120-2 3D (9.1 oz./a)	0.15 ± 0.04 a	60.0 ± 8.2 a	220.7 ± 8.2 a
F4260-7 3RIVE 3D (3.13 oz./a)	0.20 ± 0.07 a	65.0 ± 5.0 a	224.8 ± 5.5 a
F4333-1 3D (7.5 oz./a)	0.14 ± 0.05 a	75.0 ± 5.0 a	225.1 ± 10.5 a
F4333-1 3D (15 oz./a)	0.23 ± 0.05 a	55.0 ± 17.1 a	219.2 ± 5.6 a
F4334-1 3D (13.5 oz./a)	0.19 ± 0.07 a	70.0 ± 12.9 a	214.8 ± 13.3 a
F4334-1 3D (20 oz./a)	0.10 ± 0.04 a	85.0 ± 9.6 a	203.3 ± 11.7 a
Capture 3RIVE 3D (8 oz./a) + F4333-1 3D (7.5 oz./a)	0.14 ± 0.04 a	65.0 ± 12.6 a	217.4 ± 7.3 a
F9115-2 (12.8 oz./a)	0.07 ± 0.03 a	85.0 ± 9.6 a	207.1 ± 10.5 a
Force 3G (5 lb./a)	0.07 ± 0.03 a	90.0 ± 5.8 a	214.6 ± 8.6 a

[a] All means and standard errors are reported without data transformations applied

[b] Means followed by the same letter within a column are not different based on the Fisher method of least significant difference (α = 0.05)

Table 4. Analysis of variance statistics. Each analysis had 51 total degrees of freedom (Replicate = 3 df, Treatment = 12 df, Error = 36 df)

		Replicate		Treatment	
Dependent variable	Date	*F*	*P*	*F*	*P*
Stand	18 May	3.42	0.027[a]	3.22	0.003[a]
	23 May	3.79	0.018[a]	3.05	0.005[a]
	29 May	5.11	0.005[a]	4.29	< 0.001[a]
	4 June	2.60	0.067	2.67	0.011[a]
	14 June	2.88	0.050[a]	3.35	0.002[a]
Height	4 June	1.02	0.395	0.58	0.845
Root injury rating (1-6)	17 July	0.32	0.815	1.53	0.159
Root injury rating (0-3)	17 July[b]	1.75	0.175	1.64	0.125
Percent consistency	17 July	0.95	0.427	1.41	0.205
Yield	21 Sept.	4.03	0.014	0.55	0.865

[a] Effect is significant at $\alpha = 0.05$

[b] Data were transformed prior to analysis by taking the Log_{10} of $(x + 1)$